3) Padukka Exchange area is a quiet farming area about 35 km distant from the city precinct of Colombo. No much demand growth can be expected.

4) Moratuwa Exchange area embraces a large number of middle grade residences alined on both sides of Galle Road that extends north to south.

   Not a few middle sized business offices and manufacturing plants also exist. The general atmosphere is brisk.

   The road leading to Piliyandara is flanked with woodwork mills. This neighborhood constitutes the production center for high quality wooden products.

   In the southern sector also, a new road has been constructed, with signs of further development in sight. A broad demand growth can be expected.

5) Piliyandara Exchange area is completely a farming area. The demand growth will be to a limited extent only.

## 3-6 Microscopic Demand Forecast

The microscopic demand forecast for the seven exchanges whose subscriber cable networks are to be improved and expanded by the Project, plus Kollupitiya Exchange is based on the result of field survey and study of associated information and data of all kinds.

The field survey was carried out, using 1/1,000 and 1/10,000 scale maps. the associated information and data collected and studied were those relating to housing projects, as well as road and city plannings.

### 3-6-1 Exchange by Exchange Business Telephone vs. Residence Telephone Ratios

The exchange by exchange breakdown of business telephone and residence telephone installation ratios as of 1982 is given below. For Nugegoda Exchange and Mt. Lavinia Exchange, the figures are assumed.

| | Business Telephone (%) | Residence Telephone (%) |
|---|---|---|
| Colombo Central (including Mattakkuliya and Kollupitiya) | 70 | 30 |
| Havelock Town | 21 | 79 |
| Maradana | 53 | 47 |
| Nugegoda | 30 | 70 |
| Mt. Lavinia (including Boralesgamuwa) | 30 | 70 |

### 3-6-2 Classification of Areas

The classification of areas, whereby the field survey was carried out, follows:

| | |
|---|---|
| Residential Area: | High, Middle, Low grades |
| Business Office Area: | " |
| Commercial Area: | " |
| Industrial Area: | High, Middle grades |
| Other Area: | Navy, Police, Hospital, Hotel, etc. |
| No-Demand Area: | |

The result of field survey for each classified area appears in Table 3-12.

Demand density for each classified area, used for microscopic demand forecast add-on, is estimated as under:

| | 1987 | 2002 |
|---|---|---|
| Residential Area: | | |
| High grade area | 0.8-1.3 | 1.5 |
| Middle grade area | 0.5-0.8 | 1.3 |
| Low grade area | 0.07 | 0.6 |
| Business Office Area: | | |
| High grade area | 9.0 | 20.0 |
| Middle grade area | 3.5 | 9.0 |
| Low grade area | 1.3 | 2.8 |
| Commercial Area: | | |
| High grade area | 5.0 | 10.0 |
| Middle grade area | 1.1 | 2.8 |
| Low grade area | 0.3 | 1.0 |

### 3-6-3 Microscopic Demand Forecast

The microscopic demand forecast consists of add-on demand estimate by the aforementioned demand density for each classified area. Considered in this add-on demand estimate are all variable factors including the business telephone and residence telephone installation ratio at each exchange, as well as the existing features and future high-rise possibility of each area, plus the town lot readjustment under contemplation.

Table 3-12 Assembly of Houses

| Exchange Name | Residential | Business Office | Commercial | Other's | Remarks |
|---|---|---|---|---|---|
| Colombo Central | 30,560 | 2,790 | 6,490 | 300 | |
| Kollupitiya | 1,610 | 270 | 170 | 130 | |
| Mattakkuliya | 6,890 | 50 | 170 | 50 | |
| Maradana | 15,860 | 220 | 1,570 | 130 | |
| Havelock Town | 8,280 | 1,290 | 980 | 90 | |
| Nugegoda | 8,390 | 180 | 550 | 100 | |
| Mt. Lavinia | 14,200 | 140 | 930 | 190 | |
| Boralesgamuwa | 1,700 | 50 | 280 | 10 | |
| Total | 87,490 | 4,990 | 11,140 | 1,000 | |

For idle lands expected to become residential quarters in the future, the possible number of residences is assumed as under through the study of available data.

High grade residential area : 7-12 houses/hectare

Middle grade residential area: 16-21 houses/hectare

With regard to such special subscribers as government and public offices, hospitals, banks and hotels, wherein a large number of subscriber lines are required in the same building or premises, the demand forecast is made individually, based on the investigation of the number of working and waiting subscriber lines in each case.

In consideration of the exchange by exchange demand size obtained by such add-on method, and the business telephone and residence telephone installation ratio, the macroscopically forecasted demand is allocated to the seven exchanges and Kollupitiya Exchange. Details of allocation are given in Table 3-11.

3-6-4 Situation of Each Exchange Area

(1) Colombo Central Exchange Area

This area forms the political and economic center of Sri Lanka.

In the Fort Sector, many multi-stored high-rise buildings exist, among them being government and public offices, business offices and hotels. Still more high-risers are being constructed.

The Pettah Sector, though spotted with Slum-like quarters, is practically the bazaar where retail and wholesale stores stand in rows, presenting the brisk atmosphere. In the northeast of Pettah Sector a stadium is under construction and, further beyond, the factory zone extends. The high-risers are being constructed beginning from Fort side.

Along the Prince of Wales Avenue, the main road, there are signs of big office buildings and trading houses to emerge. Kollupitiya in the south and its neighborhood are gradually changing from the residential area to the business/commercial area. The housing construction is in progress along the Stace Road in the northeast and in Maradana area in the east. Maradana area, where approximately 1,500 residences already exist, is the middle grade residential area near the city center.

Special subscribers, mostly the government and public offices in the Fort Sector, presently number about 130. With more and more business offices to be accommodated in big buildings being or to be constructed from now on, the number of special subscribers is bound to increase.

(2) Kollupitiya Exchange Area

This area is located in the southern part of the existing Colombo Central Exchange area. The new Kollupitiya Exchange is to be established and begin service before 1987.

This area has so far been the high grade residential area in the city precinct of Colombo. However, because of its locational advantage of being near the city center, it is now changing into the business area. In many places along R.A. de Mel - Mavata, not to mention Galle Road, the flat houses are being rebuilt as 4-7 storied business/commercial buildings.

The expectation for increased demand for business telephones is well founded. The existing main special subscribers are:

1) Sealling Bank
2) Bank of America
3) Law Centre
4) Tea Company
5) Star Tower
6) Liberty Plaza
7) Duty Free Shop
8) Bible Society
9) Tea Board
10) Durdans Hospital

(3) Mattakkuliya Exchange Area

This area is located in the northern part of Colombo City. It is a fishing port town and, at the same time, a town of longshoremen.

This area is enclosed by Kelani River on the north and east, and by the railway on the south. It flourishes with harbor facilities and longshoremen's residences plus fishery activities. The future development will center upon the Crow Island development and the establishment of new factories taking advantage of propinquity to the harbor.

Now this area is crowded with low grade residential houses. Factors to allow rapid demand increase can seldom be found. However, considering the ease of access to the city center and the possibility of factories to be newly established, there is much to expect from the demand growth in the future.

The existing main special subscribers are:

1) Milling Corporation
2) Ceylon Fish Corporation
3) The Ceylon Oxygen Company
4) Army
5) Grove Works Ltd.
6) Janatha Estates Development Board

(4) Maradana Exchange Area

This area is located in the eastern part of Colombo City. It is a high grade residential area where public establishments of many kinds exist. Chief among them are General Hospital and Bandaranaike Memorial International Conference Hall, as well as foreign diplomatic missions including embassies.

The northern and western limits of the area border on Colombo Central Exchange area, the eastern limit on Kotte Exchange area, and the southern limit on Havelock Town Exchange area. The eastern sector is the high grade residential area.

Maradana Road that traverses the area from northwest to southeast is the main road that links the area to the city center. Along this road the commercial area develops. More and more trading houses and business buildings are expected in the future.

This area which has prospered as a bed town of Colombo City seems to be drawing close to the end of such development. The existing residential sector, being located near the city center, is expected to change gradually into the business area. This fact is sure to arouse new demand for business telephones while increasing the demand for residence telephones also.

The existing main special subscribers are:

1) Maradana Railway Station
2) Police Station
3) Water Works Engineer's Office
4) Petroleum Corporation
5) Hayley's Ltd.
6) State Distilleries Corp.
7) Hospital (cardiology)
8) General Hospital
9) Prison
10) Lipton Tea Co.
11) Colombo Municipality
12) Municipal Office
13) Eye Hospital
14) Deputy Food Controller
15) The Commission of Elections
16) Ministry of Foreign Affairs
17) Children's Hospital
18) Medical Research Institute
19) Hospital and College of Medicine

20) Maternity Hospital

21) Orient Club & Hotel

22) Canadian High Commission

23) Broadcasting Corporation

24) Audit Department

25) Bandaranaike Memorial International Conference Hall

(5) Havelock Town Exchange Area

This area located in the extreme south of Colombo City is the high grade residential area. In the northern and eastern sectors, the government and public offices are scattered. In the sector along Galle Road that extends from north to south, high-rise buildings for business/commercial offices are being constructed, beginning in the north. The sector along R.A. del Mel Mavata is also expected to follow suit.

This area, which has developed as the high grade residential area and bed town of Colombo City, is, like Kollupitiya area, changing into the business area. Many office-residences are found so that the residence telephone and business telephone installation ratio is reviewed and revised.

The existing main special subscribers are:

1) Colombo University

2) Irrigation Department

3) Bribery Commission

4) C.W.E Sport Good Dept

5) Police Station

6) Singer Company

7) Transport Ministry
8) Stores
9) National TV Station
10) President Commission
11) Mahaweli Dept. Board
12) Police Central Garage
13) Survey Department
14) Labour Ministry
15) Anti-Malaria Campaign
16) Narahenpita Govt. Party
17) National Milk Board
18) Army

(6) Nugegoda Exchange Area

This area borders on Havelock Town Exchange area on the northwest, Kotte exchange area on the northeast, Mt. Lavinia Exchange area on the west, Mahanagama Exchange area on the east and Boralesgamuwa Exchange area on the south. Nugegoda itself has developed as a local town in the suburbs of Colombo. The commercial sector centers around the Nugegoda railway station, and in its neighborhood expands the middle grade residential area.

From now forward, with the further progress of Maradana and Havelock Town Exchange area development as business/commercial quarters, Nugegoda Exchange area also is bound to develop as a bed town of Colombo. As such, the area will thrive with more and more residential and commercial houses.

The existing main special subscriber is:

1) Government Film Unit

(7) Mt. Lavinia Exchange Area

This area borders on Havelock Town Exchange and Nugegoda Exchange areas in the north, Boralesgamuwa Exchange area in the east and Moratuwa Exchange area in the south. The development so far is mainly as the high/middle grade residential plus resort area. The present formation comprises the residential area, commercial area, industrial area and seaboard resort area.

In the southeastern sector, the town lots have been readjusted and high grade residences are built. The residential building rate in this neighborhood is still 50% or thereabouts so that the construction of residences will be further accelerated in the future.

Business/commercial houses are concentrated along Galle Road that runs north to south. The most part of them are of small scale and scattered among them are office buildings. The construction of office buildings will make long strides from now onward.

The industrial area is in the southern sector. On the southern side of Ratmarana Airport are many government owned factories and their offices, as well as privately managed factories. Not a few of them are large scale factories.

This area is most typically featured in its seaboard resort. High grade hotels represented by Mt. Lavinia Hotel are built here and there on the seaboard, to accept visiting tourists from abroad. In the neighborhood of this resort area are built high grade residences and not a few cultural establishments including a university.

Although the Municipality of Mt. Lavinia is not contemplating any specific urban development, prospects loom large for this area to make greater development as a resort town with the construction of more tourist hotels and, at the same time, as a bed town of Colombo with the construction of more residential houses.

The existing main special subscribers are:

1) General Hospital

2) Mt. Lavinia Hotel

3) Colombo Airport

4) Dehiwela Zoo

5) Post Office

6) Irrigation Workshop premises

(8) Boralesgamuwa Exchange Area

This area borders on Mt. Lavinia Exchange area in the west, Nugegoda Exchange area in the north, Pennipitiya exchange area in the east and Piliyandala Exchange area in the south.

Establishments worthy of mention are the Ministry of Transportation office, factory and training center, and middle and small sized private factories scattered in the southern sector. High/middle grade residences are in the groves.

Like Mt. Lavinia Exchange and Nugegoda Exchange areas, this area will also develop as a residential area in the suburbs of Colombo.

The existing main special subscriber is:

1) Ministry of Transportation

[illegible]

[illegible]

[illegible]

# CHAPTER 4

# TELECOMMUNICATIONS NETWORK EXPANSION PLAN

[illegible]

[illegible]

[illegible]

# CHAPTER 4 TELECOMMUNICATIONS NETWORK EXPANSION PLAN

## 4-1 Service Quality Objectives

Telephone service quality objectives to apply in Sri Lanka are determined as under. Utmost efforts are to be exerted to satisfy the quality objective specified for each work category.

### 4-1-1 Connection Performance Objective

The connection performance objective is to realize the specified service quality, based on the predetermined degree of prompt, faultless connections out of all telephone calls to be connected.

(1) Loss Probability

| | |
|---|---|
| For intra-office connection | 0.005 |
| For local connection | 0.01 |
| For toll connection | 0.01 |
| For dial tone connection | |

The probability of dial tone delay exceeding 3 sec. shall be less than 0.015.

(2) Call Completion Rate

| | |
|---|---|
| Short term objective | 65% |
| Long term objective | 75% |

## 4-1-2 Transmission Performance Objective

The transmission performance objective is to realize the specified service quality, based on the predetermined degree of sound articulation of one call.

(1) National Network Reference Equivalent

| | |
|---|---|
| Toll call | Less than 29 dB |
| Local call | Less than 24 dB |

(2) Transmission Loss Distribution on Trunk Circuit

| | |
|---|---|
| Tertiary Center - Tertiary Center | 0 dB |
| Tertiary Center - Secondary Center | 0 dB |
| Secondary Center - Dependent Exchange | 4.0 dB |

(3) Transmission Loss Distribution on Subscriber Line

8 dB at 1,500 Hz

(4) Noise Distribution on Trunk Circuit

Tertiary Center - Tertiary Center:

Transmission system recommended by CCITT (10,000 pW/2,500 km)

Tertiary Center - Secondary Center:

Less than 2,000 pW

Secondary Center - Dependent Exchange:

Less than 2,000 pW

## 4-1-3 Maintenance objective

The optimum level of service not disturbed by equipment trouble, abnormal traffic and so forth is to be determined in terms of the degree of user's satisfaction, social needs and engineering economy.

(1) Subscriber System Failure Rate

Number of failures per hour $1.5 \times 10^{-5}$

(2) Connection System Unavailability due to Normal Failure

Local call $2 \times 10^{-3}$

Toll call $6 \times 10^{-3}$

(3) Connection System Unavailability due to Abnormal Failure

Local call $5 \times 10^{-4}$

Toll call $1 \times 10^{-3}$

Provided:

$$\text{Unavailability} = \frac{T_2}{(T_1 + T_2)}$$

where

$T_1$ : Normal operating time

$T_2$ : Time between loss of function and completion of repair

## 4-2 Facilities Supply Plan by Years

The facilities supply plan by years is formulated, based on exchange by exchange demand forecasts made in the preceding section. This supply plan is aimed at 100% supply of telephone facilities by the year 1997. To attain this objective, the switching equipment and subscriber cable network expansion plan is formulated as under.

4-2-1 Number of Working Subscribers

As of 1982, the working subscribers and demand (Working Subscribers plus Waiting Subscribers) in the whole of Sri Lanka number 65,905 and 94,200, respectively. The corresponding numbers in the Greater Colombo Area are 41,157 and 58,200. It's percentage of supply is approximately 70%. By far the most stringent factor is the shortage of facilities.

On the assumption that the 100% supply of facilities be realized in 1997, the facilities supply objectives are set at 90% for 1987 and 95% for 1992. And, based on these supply percentages, the average number of new working subscribers by years for the whole of Sri Lanka is calculated as under:

| | |
|---|---|
| 1983 - 1987 | Annual average: 12,200 |
| 1988 - 1992 | Annual average: 16,230 |
| 1993 - 1997 | Annual average: 23,850 |
| 1998 - 2002 | Annual average: 31,860 |

4-2-2 Additional Facilities Installation by Years

The additional facilities installation plans by years for the Greater Colombo Area are formulated as in Table 4-1. This additional facilities installation is by the following conditions:

(1) Switching equipment provisioning period ... 3 years

(2) Primary cable provisioning period ......... 5 years

The subscriber cable network improvement/expansion plans covering the seven ad hoc exchanges plus Kollupitiya Exchange are presented in Figure 4-1 through Figure 4-8.

## 4-3 Network Plan

### 4-3-1 Network Configuration

Presently, in the Greater Colombo Area, Type 4000 step by step switches are operating at six exchanges, i.e., Colombo Central, Havelock Town, Maradana, Boralesgamuwa, Moratuwa and Piliyandala; Type C400 crossbar switches at Mt. Lavinia Exchange; and E10-B digital electronic switches at Colombo Central Exchange.

E10-B at Colombo Central Exchange controls all 18 remote switching unit (RSU) in different parts of the Greater Colombo Area.

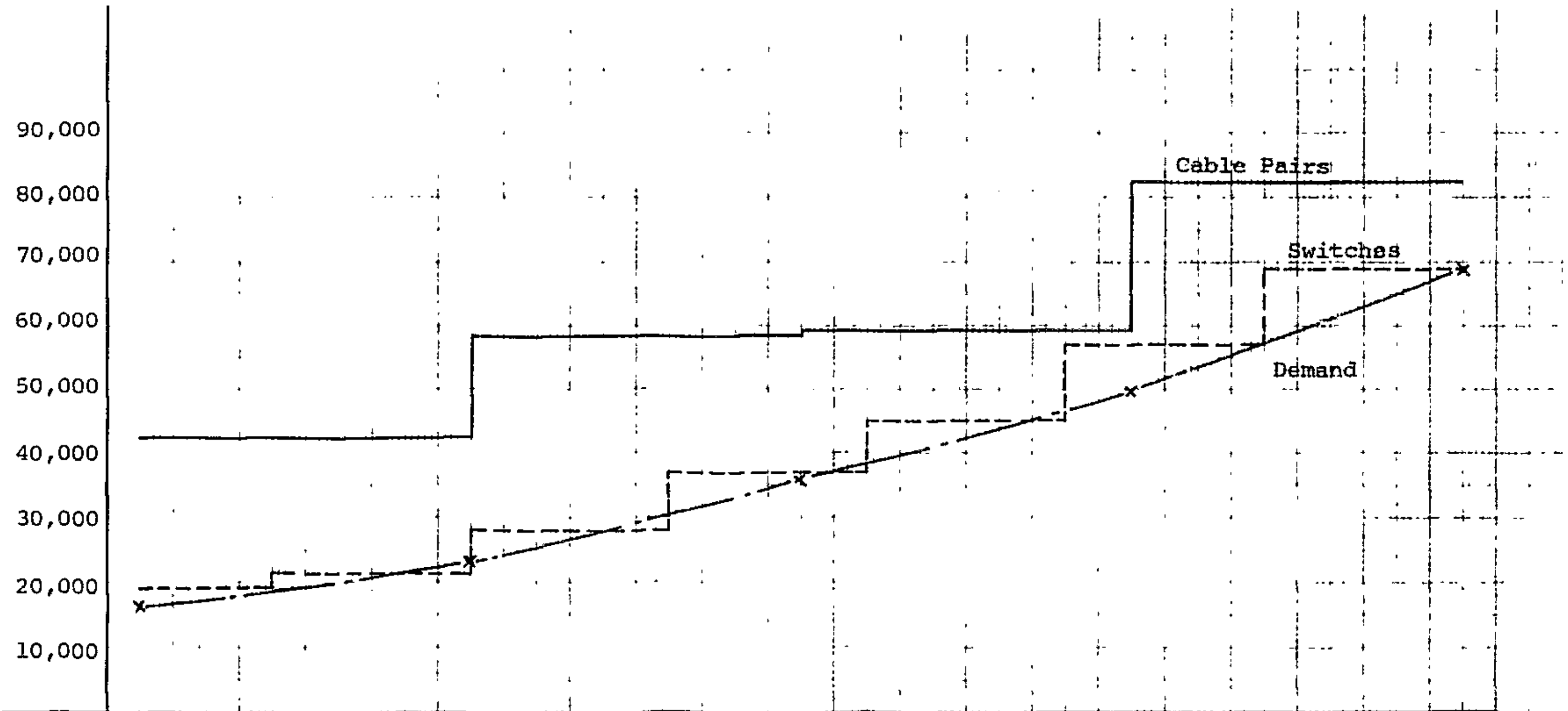
However, according to CADS III Plan schedule, E10-B master exchange will be installed at Havelock Town Exchange also and RSUs at Kollupitiya Exchange, too. By this arrangement, part of RSUs concentrated at Colombo Central Exchange will be accommodated in the newly installed E10-B at Havelock Town Exchange; step by step switches at Boralesgamuwa Exchange will be withdrawn and subscribers will be newly accommodated at Mr. Lavinia Exchange.

With regard to CADS IV Plan to follow, work specifications are still in the making. As of the present, no decision has yet been made except replacing all step by step switches in the Greater Colombo Area with digital electronic switches.

Table 4-1 Facilities Supply Plan

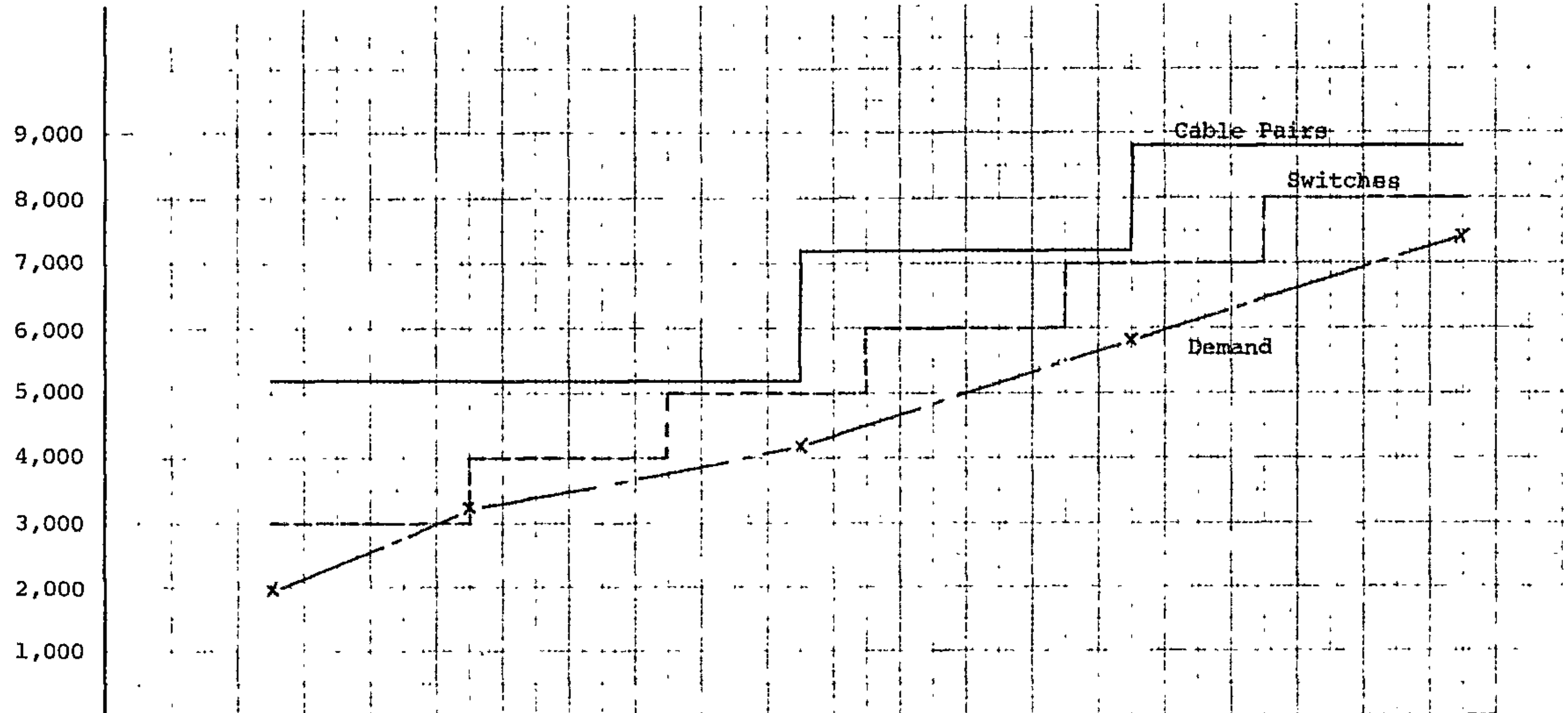
(Line Units)

| No. | Exchange Name | 1987 | 1990 | 1993 | 1996 | 1999 | 2002 |
|---|---|---|---|---|---|---|---|
| 1 | Colombo Central | 21,650 | 28,000 | 37,000 | 45,000 | 57,000 | 69,000 |
| 2 | Kollupitiya | 3,000 | 4,000 | 5,000 | 6,000 | 7,000 | 8,000 |
| 3 | Mattakkuliya | 2,000 | 3,000 | 5,000 | 6,000 | 8,000 | 10,000 |
| 4 | Maradana | 8,500 | 12,000 | 15,000 | 18,000 | 24,000 | 29,000 |
| 5 | Havelock Town | 8,000 | 13,000 | 16,000 | 20,000 | 26,000 | 32,000 |
| 6 | Nugegoda | 4,500 | 7,000 | 9,000 | 11,000 | 14,000 | 16,000 |
| 7 | Mt. Lavinia | 12,000 | 12,000 | 15,000 | 18,000 | 22,000 | 27,000 |
| 8 | Boralesgamuwa | - | 1,000 | 2,000 | 2,000 | 2,000 | 3,000 |
| | Sub Total | 59,650 | 80,000 | 104,000 | 126,000 | 160,000 | 194,000 |
| 9 | Wattala | 1,850 | 3,000 | 4,000 | 5,000 | 6,000 | 9,000 |
| 10 | Ragama | 450 | 1,000 | 2,000 | 2,000 | 3,000 | 4,000 |
| 11 | Ja-Ela | 1,250 | 2,000 | 4,000 | 5,000 | 7,000 | 10,000 |
| 12 | Kelaniya | 1,750 | 3,000 | 4,000 | 6,000 | 8,000 | 11,000 |
| 13 | Kadawata | 600 | 2,000 | 3,000 | 4,000 | 6,000 | 9,000 |
| 14 | Biyagama<br>Malwana | } 300 | } 2,000 | } 3,000 | } 4,000 | } 6,000 | } 8,000 |
| 15 | Wellampitiya | 550 | 2,000 | 3,000 | 4,000 | 6,000 | 8,000 |
| 16 | Angoda | 450 | 1,000 | 2,000 | 3,000 | 5,000 | 6,000 |
| 17 | Kaduwela | 300 | 1,000 | 1,000 | 2,000 | 3,000 | 4.000 |
| 18 | Kotte | 4,250 | 6,000 | 8,000 | 10,000 | 13,000 | 16,000 |
| 19 | Hokandara | 400 | 1,000 | 1,000 | 2.000 | 3,000 | 4,000 |
| 20 | Maharagama | 2,000 | 3,000 | 4,000 | 5,000 | 7,000 | 9.000 |
| 21 | Homagama | 1.000 | 1,000 | 2,000 | 3.000 | 4,000 | 6,000 |
| 22 | Padukka | 500 | 1,000 | 1,000 | 2,000 | 3.000 | 4,000 |
| 23 | Moratuwa | 2,000 | 4,000 | 6.000 | 8,000 | 10,000 | 13,000 |
| 24 | Piliyandala | 500 | 1,000 | 1,000 | 2.000 | 2,000 | 4,000 |
| | Sub Total | 18,150 | 34,000 | 49,000 | 67,000 | 92,000 | 125,000 |
| | Total | 77,800 | 114,000 | 153,000 | 193,000 | 252,000 | 319.000 |



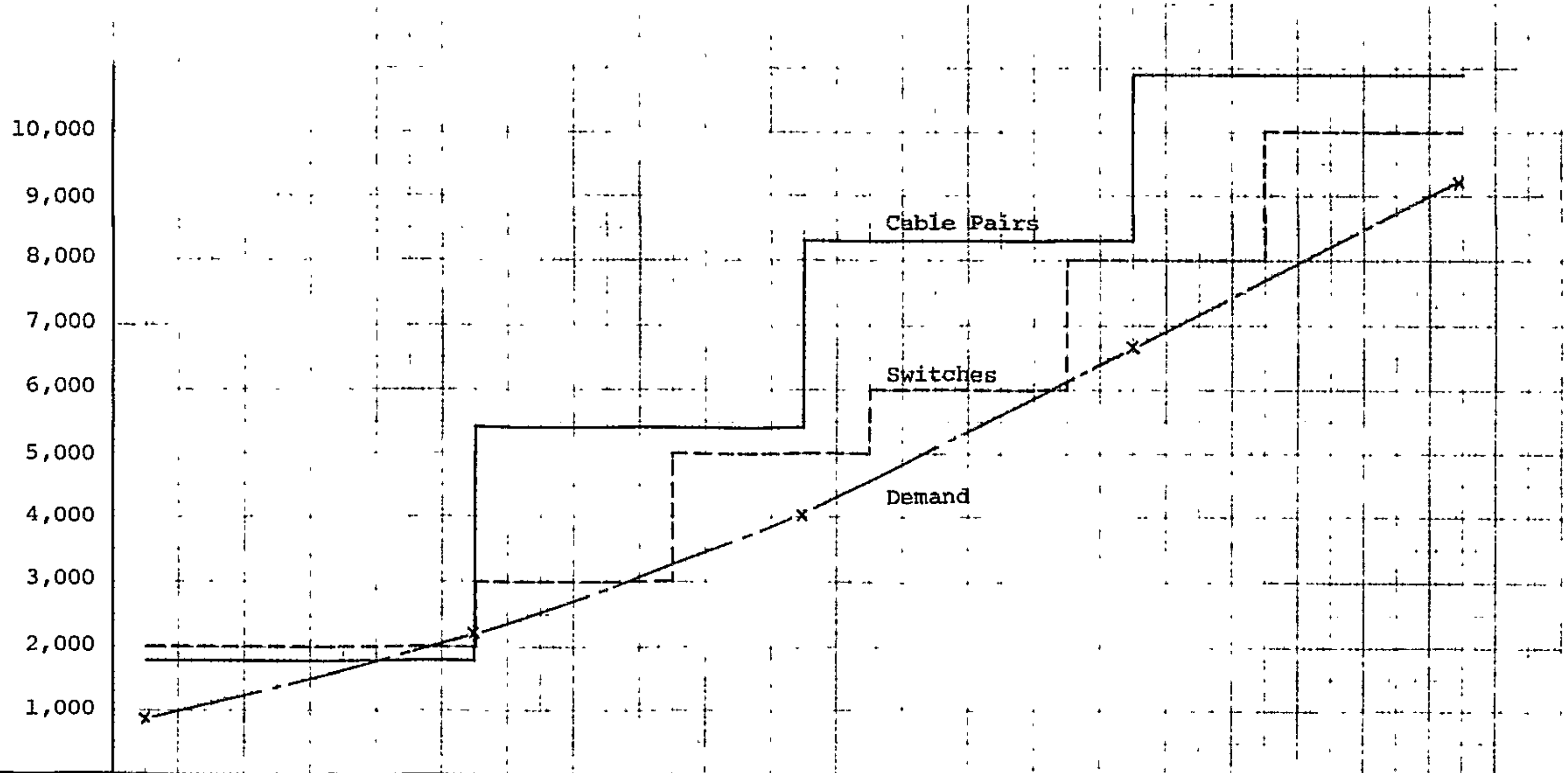

| YEAR | 1982 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 2000 | 01 | 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEMAND | 16,387 | | | | | 23,380 | | | | | 36,050 | | | | | 49,810 | | | | | 68,700 |
| SWITCHES | 19,650 | | 21,650 | | | 28,000 | | | 37,000 | | | 45,000 | | | 57,000 | | | 69,000 | | | |
| CABLE PAIRS | 42,700 | | | | | 58,300 | | | | | 59,800 | | | | | 82,500 | | | | | |
| REMARKS | | | | | | | | | | | | | | | | | | | | | |

Figure 4-1 Supply Plan of Subscriber - Colombo Central Exchange Area -



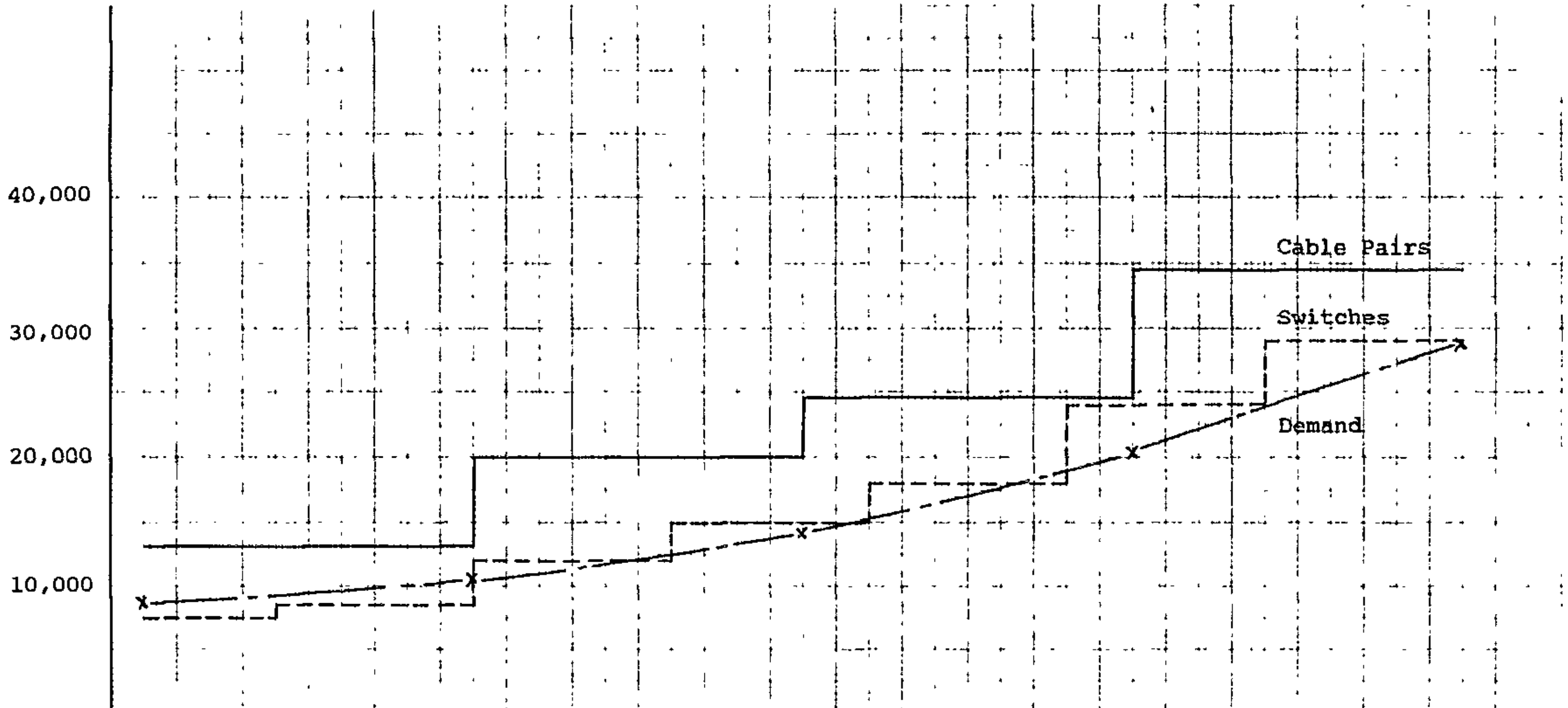

| YEAR | 1982 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 2000 | 01 | 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEMAND | | | 1,950 | | | 3,250 | | | | | 4,130 | | | | | 5,950 | | | | | 7,350 |
| SWITCHES | | | 3,000 | | | 4,000 | | | 5,000 | | | 6,000 | | | 7,000 | | | 8,000 | | | |
| CABLE PAIRS | | | 5,200 | | | 5,200 | | | | | 7,200 | | | | | 8,800 | | | | | |
| REMARKS | Out of the Project | | | | | | | | | | | | | | | | | | | | |

Figure 4-2 Supply Plan of Subscriber - Kollupitiya Exchange Area -



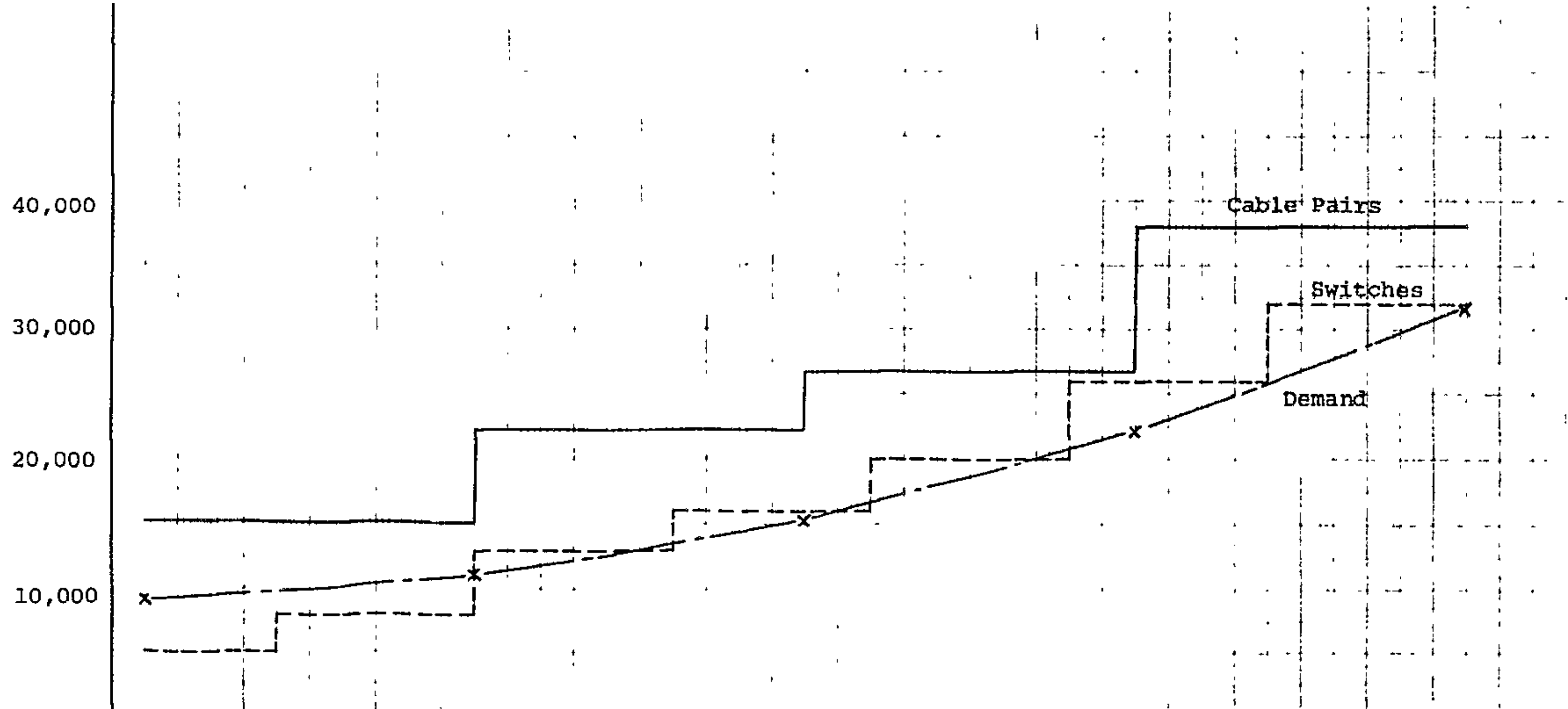

| YEAR | 1982 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 2000 | 01 | 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEMAND | 866 | | | | | 2,200 | | | | | 3,990 | | | | | 6,700 | | | | | 9,120 |
| SWITCHES | 2,000 | | | | | 3,000 | | | 5,000 | | | 6,000 | | | 8,000 | | | 10,000 | | | |
| CABLE PAIRS | 1,800 | | | | | 5,400 | | | | | 8,300 | | | | | 10,900 | | | | | |
| REMARKS | | | | | | | | | | | | | | | | | | | | | |

Figures 4-3 Supply Plan of Subscriber - Mattakkuliya Exchange Area -



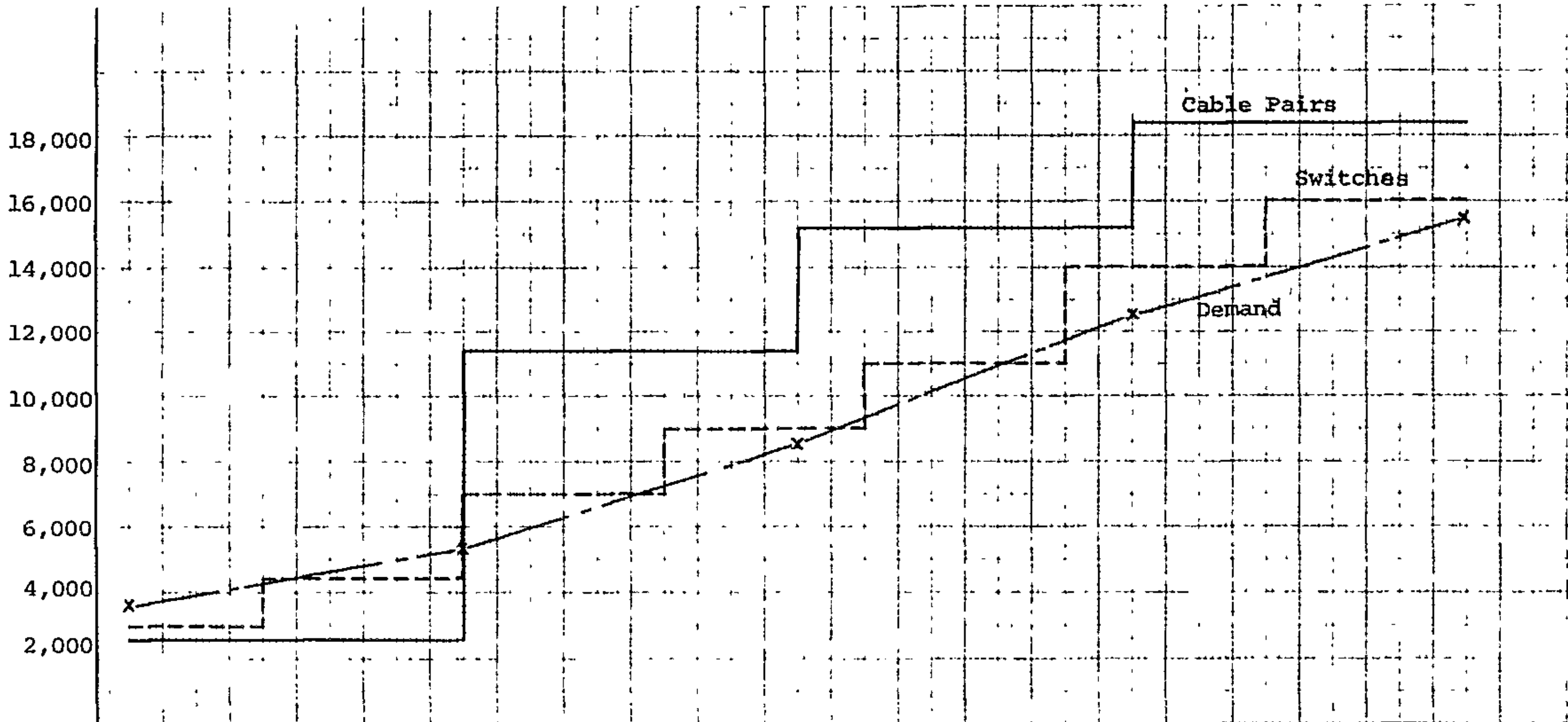

| YEAR | 1982 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 2000 | 01 | 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEMAND | 8,769 | | | | | 10,660 | | | | | 14,400 | | | | | 20,610 | | | | | 28,910 |
| SWITCHES | 7,500 | | 8,500 | | | 12,000 | | | 15,000 | | | 18,000 | | | 24,000 | | | 29,000 | | | |
| CABLE PAIRS | 13,200 | | | | | 20,000 | | | | | 24,700 | | | | | 34700 | | | | | |
| REMARKS | | | | | | | | | | | | | | | | | | | | | |

Figure 4-4 Supply Plan of Subscriber - Maradana Exchange Area -



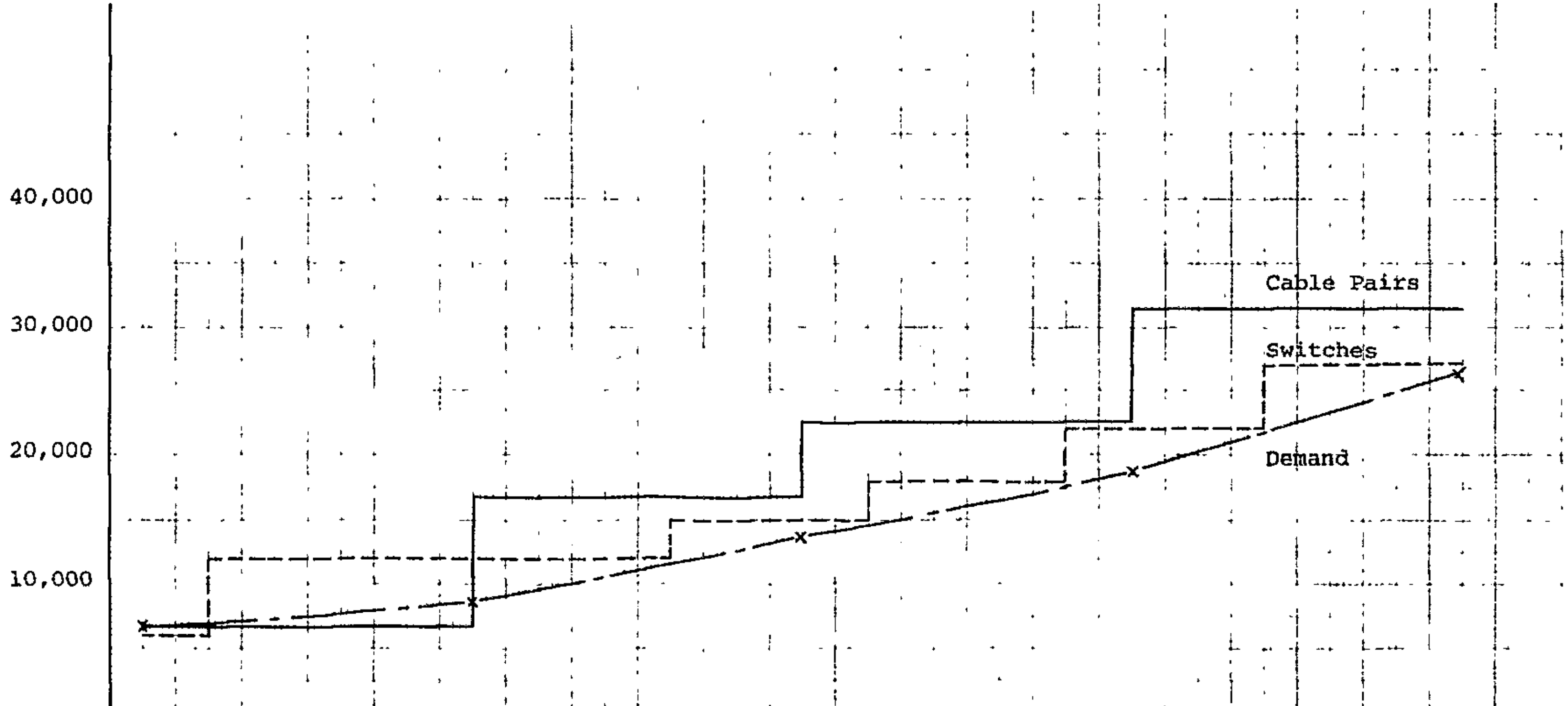

| YEAR | 1982 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 2000 | 01 | 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEMAND | 9,235 | | | | | 11,380 | | | | | 15,640 | | | | | 22,370 | | | | | 31,580 |
| SWITCHES | 5,000 | | 8,000 | | | 13,000 | | | 16,000 | | | 20,000 | | | 26,000 | | | 32,000 | | | |
| CABLE PAIRS | 15,200 | | | | | 22,400 | | | | | 26,800 | | | | | 37,900 | | | | | |
| REMARKS | | | | | | | | | | | | | | | | | | | | | |

Figure 4-5 Supply Plan of Subscriber - Havelock Town Exchange Area -



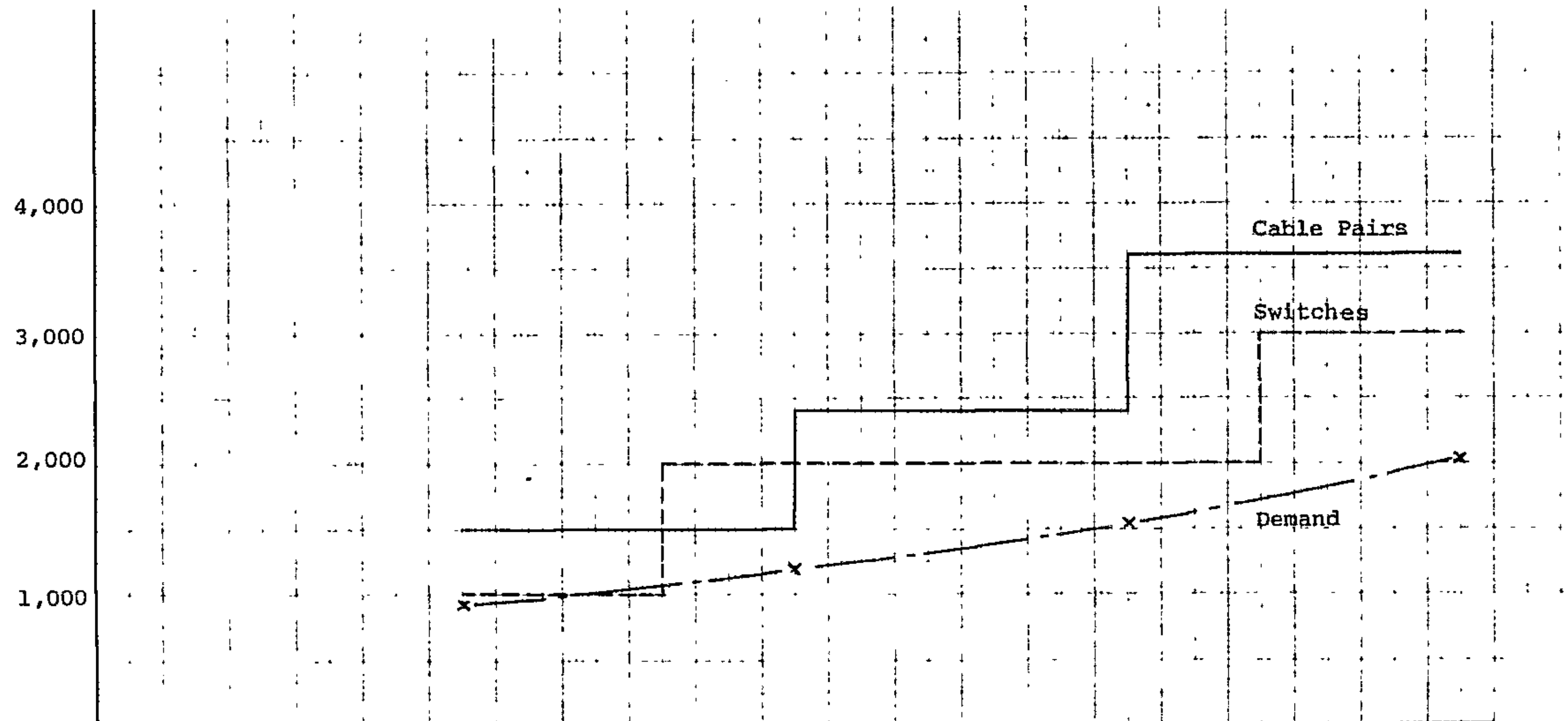

| YEAR | 1982 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 2000 | 01 | 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEMAND | 3,639 | | | | | 5,410 | | | | | 8,450 | | | | | 12,620 | | | | | 15,310 |
| SWITCHES | 3,000 | | 4,500 | | | 7,000 | | | 9,000 | | | 11,000 | | | 14,000 | | | 16,000 | | | |
| CABLE PAIRS | 2,600 | | | | | 11,400 | | | | | 15,200 | | | | | 18,400 | | | | | |
| REMARKS | | | | | | | | | | | | | | | | | | | | | |

Figure 4-6 Supply Plan of Subscriber - Nugegoda Exchange Area -




| YEAR | 1982 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 2000 | 01 | 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEMAND | 6,986 | | | | | 8,700 | | | | | 13,760 | | | | | 18,680 | | | | | 26,210 |
| SWITCHES | 6,000 | 12,000 | | | | 12,000 | | | 15,000 | | | 18,000 | | | 22,000 | | | 27,000 | | | |
| CABLE PAIRS | 6,900 | | | | | 16,900 | | | | | 22,500 | | | | | 31,500 | | | | | |
| REMARKS | Including Baralesgamuwa Area → (to 87) | | | | | | | | | | | | | | | | | | | | |

Figure 4-7 Supply Plan of Subscriber - Mt. Lavinia Exchange Area -




| YEAR | 1982 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 2000 | 01 | 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEMAND | - | | | | | 930 | | | | | 1,200 | | | | | 1,550 | | | | | 2,040 |
| SWITCHES | - | | | | | 1,000 | | | 2,000 | | | 2,000 | | | 2,000 | | | 3000 | | | |
| CABLE PAIRS | - | | | | | 1,500 | | | | | 2,400 | | | | | 3,600 | | | | | |
| REMARKS | | | | | | | | | | | | | | | | | | | | | |

Figure 4-8 Supply Plan of Subscriber - Boralesgamuwa Exchange Area -

E10-B system now operating in the Greater Colombo Area is one of digital switching systems earliest developed in the world. Therefore, when compared with the later developed system, it undeniably is inferior in all performances. Its call handling capacity, traffic capacity and terminal capacity are much smaller than those of digital switches of recent make. Its use in a big city, where both the calling rate and the ineffective call rate are high, is economically disadvantageous.

Furthermore, RSUs are devoid of stand alone performance capability so that they cannot operate in the event of circuit failure between them and their master exchange. Hence, from now forward, in the Greater Colombo Area, the large type, new model digital switches should be introduced.

Nevertheless, for the junction network formulation, this time, the assumption is that E10-B will continue to be used.

In the Project, the number of master exchanges to control RSUs will be increased to five from the existing three. This is to reduce possibility of service deterioration of RSUs due to system-down of their master exchange, and also to follow suit in the light of the numbering plan, maintenance system, and master exchange capacity. The five master exchanges are Kelaniya, Colombo Central, Maradana, Havelock Town and Mt. Lavinia.

Boralesgamuwa Exchange, where step by step switches are to be withdrawn by CADS III Plan but where the subscriber line transmission loss objective cannot be satisfied, is to be reactivated as RSU.

Figure 4-9 presents the present and future network configurations. Table 4-2 is the exchange by exchange breakdown of switches by types and their existing number of terminals.

4-3-2 Numbering Plan

The national number consists of prefix + area code + exchange code + subscriber number. In several multiexchange areas including Colombo, the local call numbering is exchange code + subscriber number; however, in almost all cities, only the subscriber number has to be dialled.

At present, the linked numbering inside the secondary center area is being planned. According to this numbering plan, the call to any exchange in the same secondary center area does not require the area code, and only the exchange code and subscriber number are to be dialled.

Numberings for special services have not yet been standardized for nationwide use. In the future, they will be standardized to three digits of "1XY."

International subscriber dialling identified by prefix "00."

Area codes in the whole country, special service codes and exchange codes for the Greater Colombo Area are presented in Table 4-3, Table 4-4 and Table 4-5, respectively.

Table 4-2 Present Situation of Telephone Exchanges in Greater Colombo

| Name of Exchange | Abbr. | Type of Eqp. | Line Capacity | | Note |
|---|---|---|---|---|---|
| | | | CADS II | CADS III | |
| Colombo Central | CO | STC 4000 | 13,500 | 8,000 | |
| " | " | CIT E10-B | 2,000 | 7,650 | |
| Kollupitiya | KPT | CIT RSU | - | 3,000 | |
| Mattakkuliya | MTK | " | 2,000 | 2,000 | |
| Maradana | MD | STC 4000 | 3,500 | 4,500 | |
| " | " | CIT RSU | 4,000 | 4,000 | |
| Havelock Town | HK | STC 4000 | 4,500 | - | |
| " | " | CIT RSU | 5,000 | - | |
| " | " | CIT E10-B | - | 13,000 | |
| Nugegoda | ND | CIT RSU | 3,000 | 4,500 | |
| Mt. Lavinia | MV | NEC C400 | 6,000 | 12,000 | |
| Boralesgamuwa | BS | STC 4000 | 100 | - | To be included in MV area |
| Wattala | WT | CIT RSU | 1,400 | 1,850 | |
| Ragama | RG | " | 450 | 450 | |
| Ja-Ela | JL | " | 1,250 | 1,250 | |
| Kelaniya | KI | " | 1,250 | 1,750 | |
| Kadawata | KDW | " | 600 | 600 | |
| Malwana | MAL | " | 300 | 300 | |
| Wellampitiya | WI | " | 550 | 550 | |
| Angoda | AN | " | 450 | 450 | |
| Kaduwela | KDL | " | 300 | 300 | |
| Kotte | KX | " | 2,750 | 4,250 | |
| Hokandara | HC | " | 200 | 300 | |
| Maharagama | MHG | " | 900 | 2,000 | |
| Homogama | HO | " | 450 | 1,000 | |
| Padukka | PK | " | 300 | 500 | |
| Moratuwa | MF | STC 4000 | 880 | - | |
| " | " | CIT RSU | - | 2,000 | |
| Piliyandara | PYL | STC 4000 | 200 | - | |
| " | " | CIT RSU | - | 500 | |

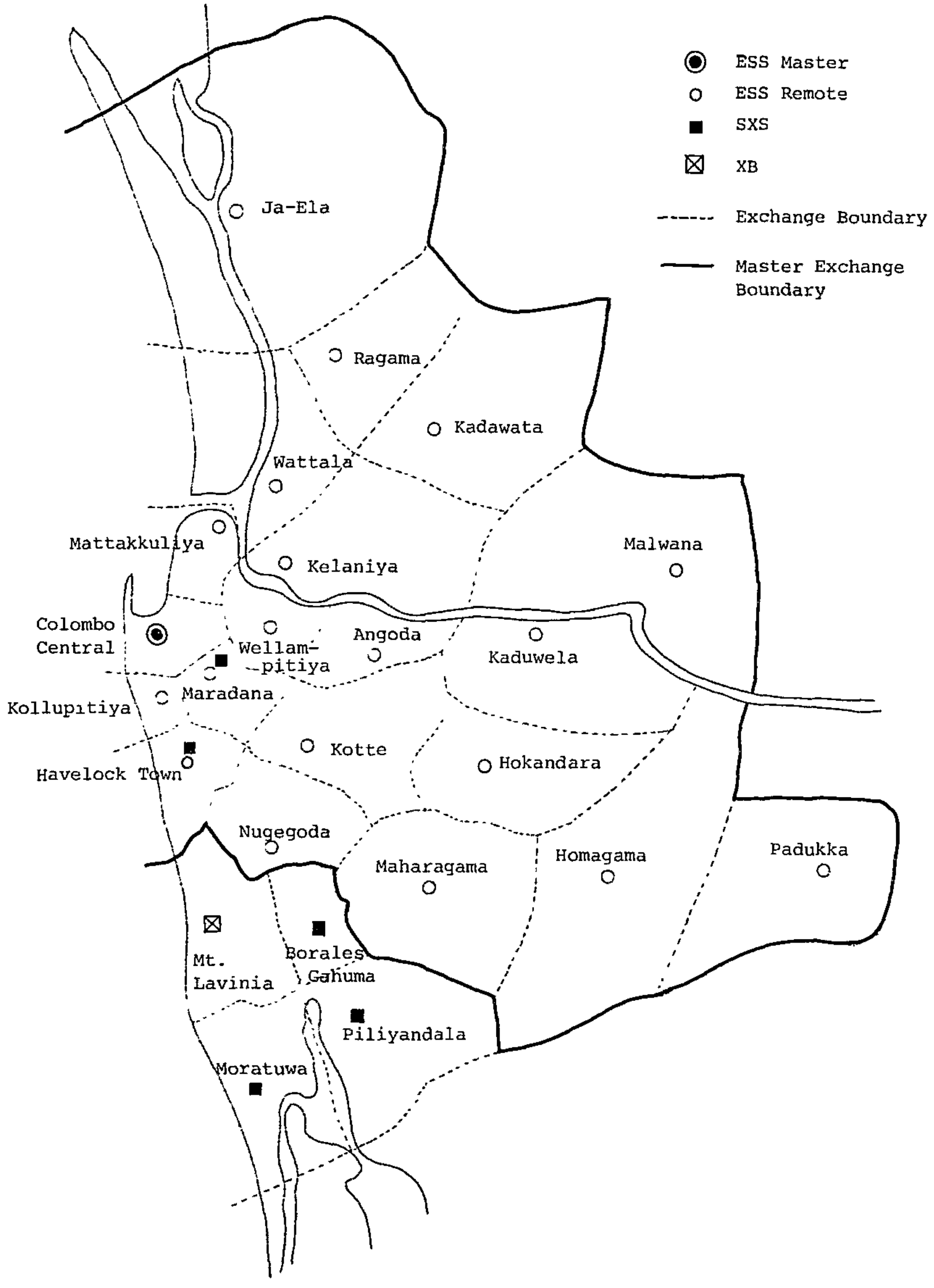



Figure 4-9 (1/3) Existing Exchange Allocation

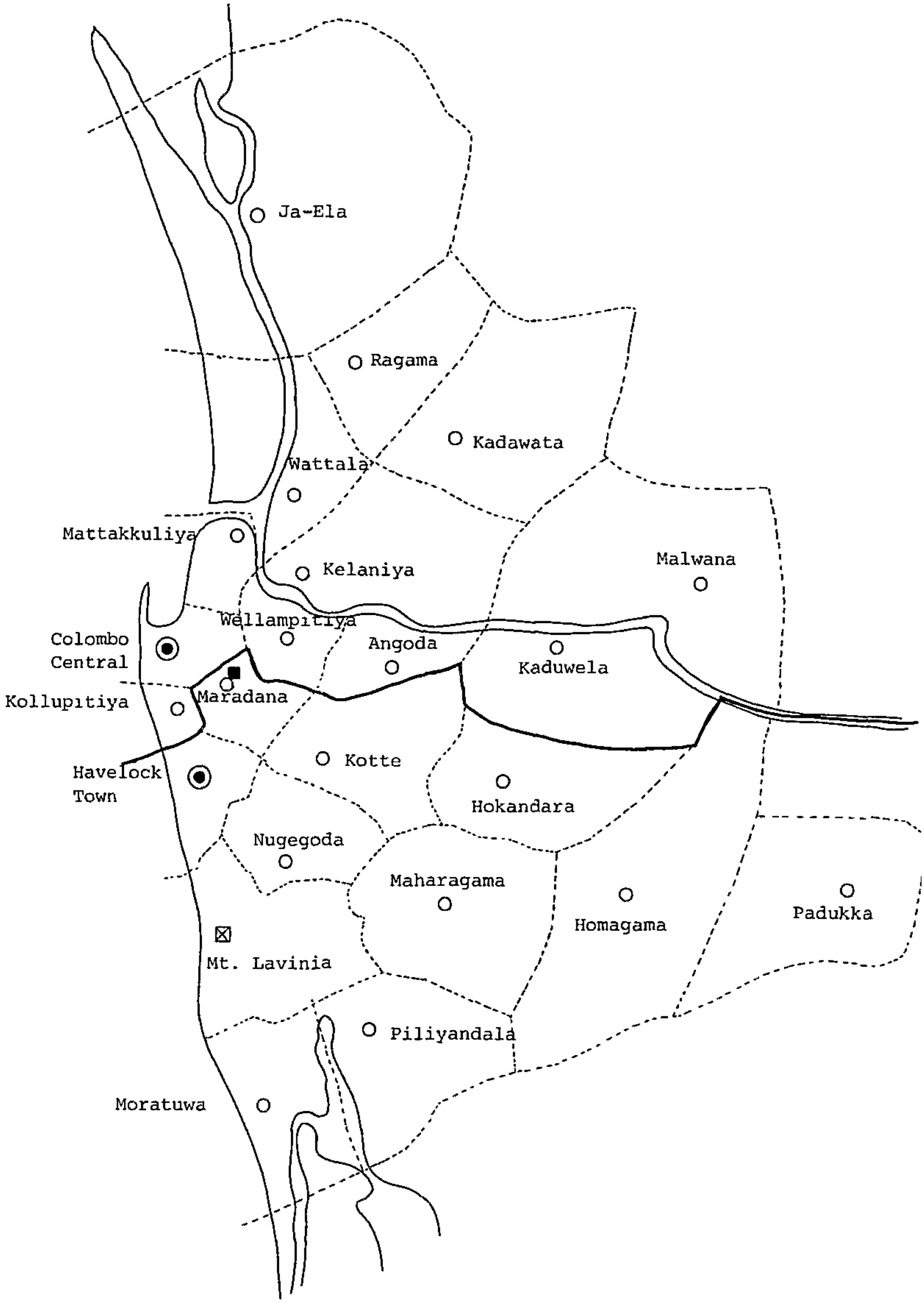



Figure 4-9 (2/3) Exchange Allocation Plan for CADS III

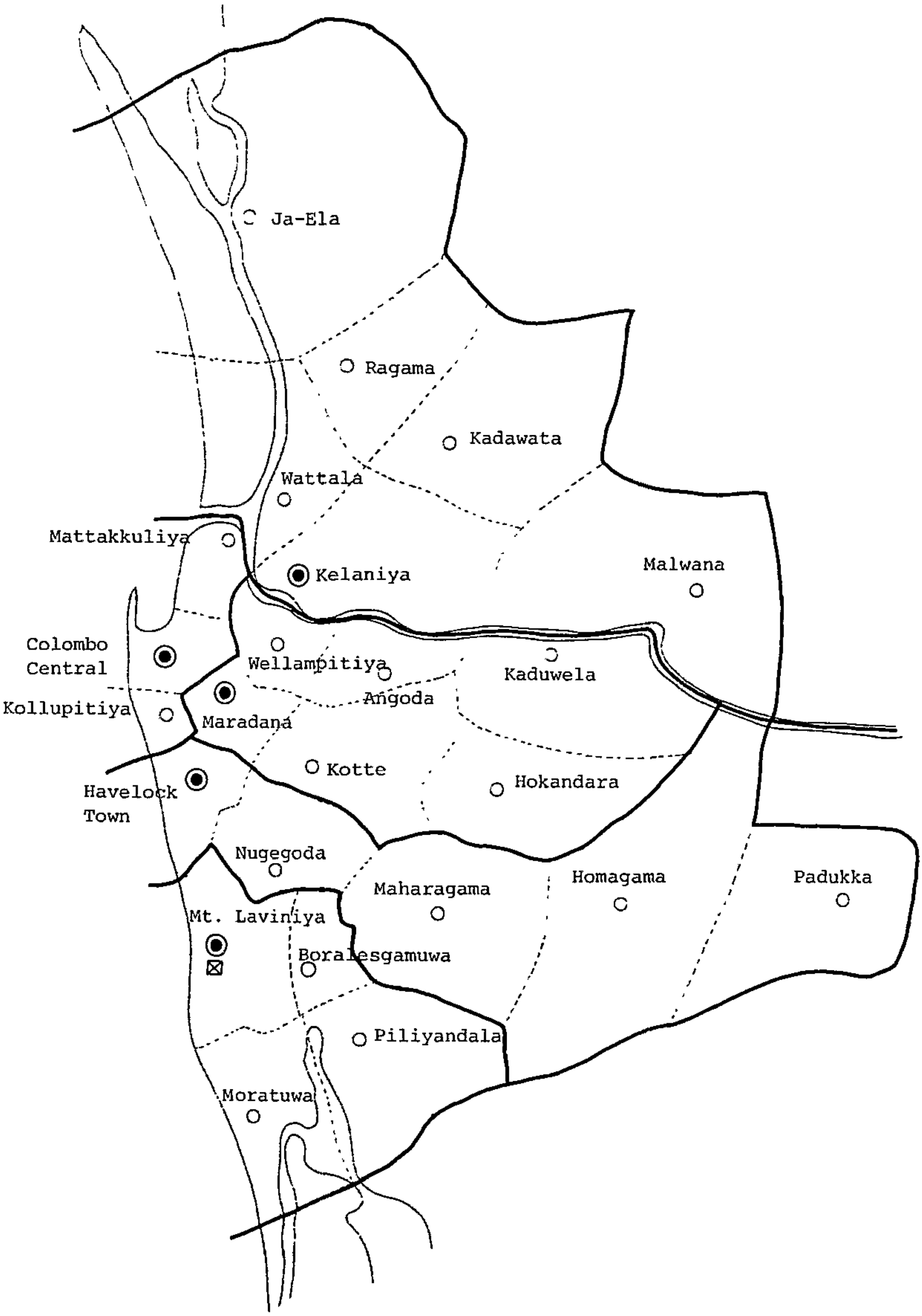



Figure 4-9 (3/3) Exchange Allocation Plan (1992 - 2002)

The existing numbering plan in the Greater Colombo Area allocates five digits using "2," "3," "8" or "9" as exchange code to each step by step exchange, six digits using "71" as exchange code to Mt. Lavinia Exchange, and six digits using "5" as first digit to other digital electronic exchanges.

Boralesgamuwa, Moratuwa and Piliyandala Exchanges in the suburbs of Colombo are given their respective trunk codes of "0794," "072" and "0795." These three exchanges are not included in the local network of Colombo at present.

When CADS IV Plan terminates, step by step exchanges will no longer exist in the Greater Colombo Area. And the uniform six-digit numbering will come into practice.

Although the special service codes consist of three digits of "1XY," in principle, "22222" and "33333" of the general subscriber number category are used for police and fire/ambulance services, respectively. This is to prevent erroneous connections due to false pulses.

As seen in Table 4-5, almost all exchange codes in the Greater Colombo Area presently use "5" as first digit. This arrangement causes the numbering capacity to become deficient when the Greater Colombo Area subscribers increase to 60,000 - 70,000 so that the numbering plan must be changed as soon as possible.

The numbering changes entail so much trouble on the authorities concerned as they necessitate, among others, the exchange data modification for electronic switches, subscriber familiarization about new numbers, and alteration of plant records of all kinds. Subscribers, for their part, are bound to suffer inconvenience before they become completely acquainted with new numbers.

The new numbering plan must be established with special emphasis on the following points:

- To make number allocations with sufficient margins so that further number changes will not be necessary for a long time.

- To so arrange that the area identification by the first digit or by the first and second digits is possible.

- To reserve codes for new services that may be realized in the future, such as mobile telephone and paging services.

The present numbering plan and example of new numbering plan are shown in Table 4-10 and Table 4-11

With regard to "22222" for police and "33333" for fire and ambulance, the problems involved are twofold:

- These numbers must be short as possible.

- These numbers must be also easy memorable and be avoided making miss dialling.

These problems are portentous because the special services concerned are of emergency nature.

Table 4-3 Area Code for STD Network

| Tertiary Zone | Area Code Present | Area Code Future | Area | Note |
|---|---|---|---|---|
| Colombo | 01 | 01 | Colombo | |
| | 031 | 031 | Negombo | |
| | 032 | 032 | Chilaw | |
| | 033 | 033 | Gampaha | |
| | 042 | 034 | Kalutara | Area code will be changed in future |
| | - | 035 | Kegalle | Including STD network after IDA project |
| | 036 | 036 | Avissawella | |
| | 037 | 037 | Kurunegala | |
| | 030 | | F.T.Z. | |
| Kandy | 08 | 08 | Kandy | |
| | 051 | 051 | Hatton | |
| | 052 | 052 | Nuwara Eliya | |
| | 054 | 054 | Nawalapitiya | |
| | 055 | 055 | Badulla | |
| | - | 057 | Bandarawela | Including STD network after IDA project |
| | 063 | 063 | Ampara | |
| | 065 | 065 | Batticaloa | |
| | 066 | 066 | Matale | |
| Anuradhapura | 021 | 021 | Jaffna | |
| | 023 | 023 | Mannar | |
| | 024 | 024 | Vavuniya | |
| | 025 | 025 | Anuradhapura | |
| | 026 | 026 | Trincomalee | |
| | 027 | 027 | Polonnaruwa | |
| Galle | 09 | 09 | Galle | |
| | 041 | 041 | Matara | |
| | 045 | 045 | Ratnapura | |
| | 046 | - | Pandura | will be included Kalutara area |
| | 047 | 047 | Hambantota | |
| | 048 | - | Bentota | will be included Kalutara area |

Table 4-4 Special Service Code

| Service | Code | |
|---|---|---|
| Assistance and Trunk Booking | 101 | |
| Emergency | 125 | *1 |
| Priority Trunk Booking | 120 | |
| Indian Trunk Booking | 130 | |
| Directory Enquiries - Sinhala | 136 | |
| Directory Enquiries - Tamil | 137 | |
| Directory Enquiries - English | 138 | |
| Enquiries - Sinhala | 141 | |
| Enquiries - Tamil | 151 | |
| Enquiries - English | 161 | |
| Phonogram - Sinhala | 131 | |
| Phonogram - Tamil | 132 | |
| Phonogram - English | 133 | |
| Telephone - Telegram | 181 | |
| Time - Sinhala | 171 | |
| Time - Tamil | 172 | |
| Time - English | 173 | |
| Complaints | 121 | *2 |
| Testing by Faultsman | 191 | |
| Faultsman's Ringback | 129 | |
| Foreign Booking by S.C Operator | 110 | |
| Overseas Trunk Booking | 100 | |

*1: In Colombo area, 22222 for Police and 33333 for Fire and Ambulance

*2: In Colombo area, 121 for Central SXS, 122 for Havelock Town SXS, 123 for Maradana SXS and 124 for other all exchanges

Table 4-5 Exchange Code in Greater Colombo Area as of CADS II/III

| Exchange Code | Type of Equipment | Name of Exchange |
|---|---|---|
| 2/3 | STC Type 4000 | Colombo Central |
| 540 ~ 549 | CIT E10-B | " |
| 523 ~ 524 | CIT E10-RSU | Mattakkuliya |
| 573 ~ 577 | " | Kollupitiya |
| 9 | STC Type 4000 | Maradana |
| 590 ~ 599 | CIT E10-RSU | " |
| 8 | STC Type 4000 | Havelock Town |
| 580~589, 500~503 | CIT E10-RSU | " |
| 522~524, 556~558 | " | Nugegoda |
| 71 | NEC C400 | Mt. Lavinia |
| 536 ~ 537 | CIT E10-RSU | Ja-Ela |
| 538 | " | Ragama |
| 525 | " | Kadawata |
| 530 ~ 531 | " | Wattala |
| 520 ~ 521 | " | Kelaniya |
| 5715 ~ 5719 | " | Malwana |
| 572 | " | Wellampitiya |
| 578 | " | Angoda |
| 5710 ~ 5714 | " | Kadwela |
| 5615~5619, 562~569 | " | Kotte |
| 5610 ~ 5614 | " | Hokandara |
| 550 ~ 551 | " | Maharagama |
| 555 | " | Homagama |
| 559 | " | Padukka |
| 072 | STC Type 4000 | Moratuwa |
| 0794 | " | Boralesgamuwa |
| 0795 | STC & ITI Type 4000 | Piliyandala |

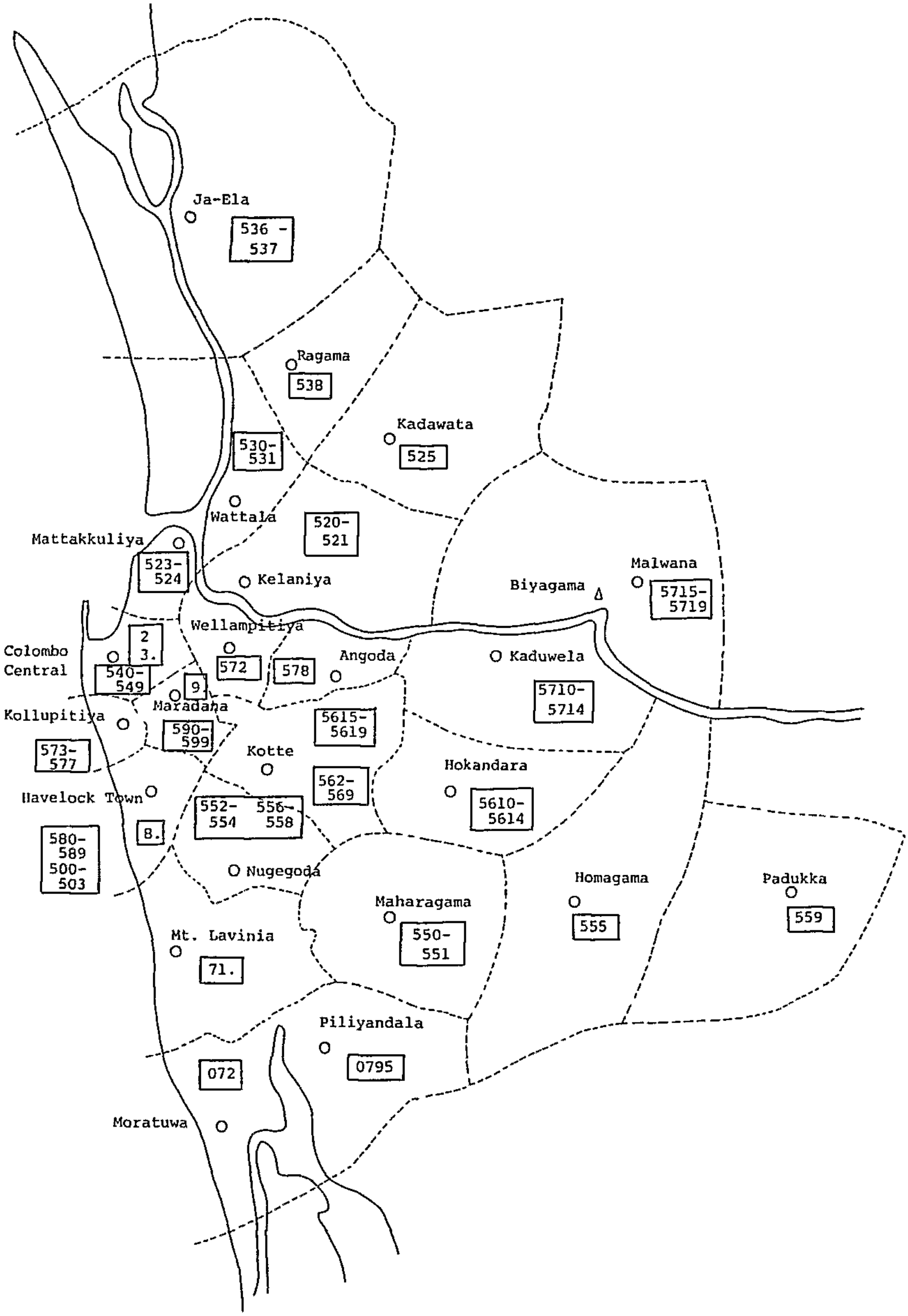



Figure 4-10 Present Numbering Plan for Greater Colombo Area

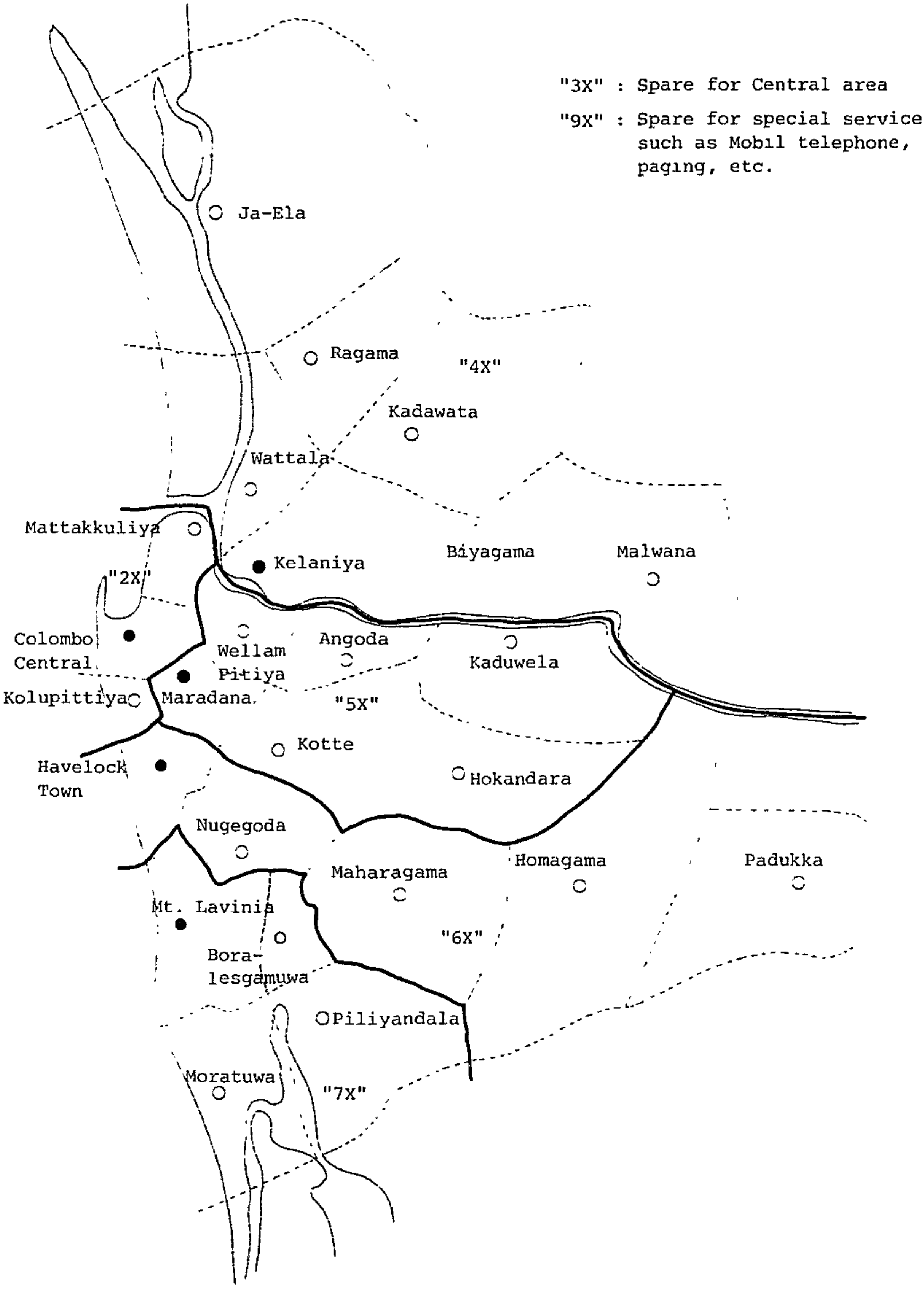



Figure 4-11 An Example of Numbering Plan for Greater Colombo Area

In view of the improved dialling facilities of the telephone set, these days, and the consequent downtrend of miss dialling probability, those two special service numbers should be chosen out of "1XY" series.

Outside of the Greater Colombo Area, a single emergency number of "125" is used for the said two special services combined. However, in the Greater Colombo Area, those special services are being practiced separately, the separate numbers should be used for them.

### 4-3-3 Charging Plan

Each local call is charged by unit call duration of 120 seconds. The standard charge per unit is 70 cents.

The step by step exchange is not equipped for local multi-metering so that each local call is charged with 70 cents regardless of call duration.

For calls from subscribers of Boralesgamuwa, Moratuwa and Piliyandala Exchanges in the suburbs of Colombo to the subscribers inside the city precinct, and vice versa, the charge is 70 cents per unit of 120 seconds duration as in the case of local calls. For Local calls among the three exchanges mentioned, the charge is 70 cents per call regardless of call duration.

Charging rates for toll calls vary according to call duration and distance. For STD call, the charge on shortest distance call is 70 cents per 50 seconds and the charge on longest distance call is 70 cents per 10 seconds.

For toll connections via manual switchboard, the charge on shortest distance call is 3 rupees and 60 cents for the first three minutes subject to the additional charge of 12 rupees and 60 cents for every succeeding three minutes. The charge on longest distance call is 13 rupees and 60 cents for the first three minutes subject to the additional charge of 12 rupees and 60 cents for every succeeding three minutes.

For both STD calls and toll connections via manual switchboard, the discount rates are applicable to night calls.

For special service calls, directory assistance and time announcement are chargeable. All others are free of charge.

Charging rates for STD calls and operator assisted toll connections are listed in Table 4-6 and Table 4-7, respectively.

4-3-4 Transmission Route Plan

The existing main toll transmission routes comprise microwave route, UHF route, VHF route and coaxial cable route.

All these transmission routes are of analogue system. Therefore, even in case the toll exchanges are equipped with the digital electronic switching system, the connections have had to be carried out after A/D (analogue to digital) conversion. However, by the IDA Project, the digital microwave systems of 8 GHz, 4 GHz and 2 GHz, as well as UHF links, are to be established to connect principal cities mutually. Thus the digital transmission network worth the name is to come into being though in parts of the country.

Table 4-6 Charge Steps for STD Call

| Distance | Standard Rate 6 a.m. to 9 p.m. | Cheap Rate 9 p.m. to 6 a.m. |
|---|---|---|
| ~ 20 miles | 50 Secs. | 100 Secs. |
| 20 ~ 50 miles | 30 Secs. | 60 Secs. |
| 50 ~ 70 miles | 18 Secs. | 36 Secs. |
| 70 ~ 120 miles | 15 Secs. | 30 Secs. |
| 120 miles ~ | 10 Secs. | 20 Secs. |

Table 4-7 Charge Steps for Toll Call Connected by Operator

| Distance | Standard Rate 6 a.m. to 9 p.m. | | Cheap Rate 9 p.m. to 6 a.m. | |
|---|---|---|---|---|
| | 1st 3 mts. or part thereof Rs. | Addl. 3mts. or Part thereof Rs. | 1st 3mts. or Part thereof Rs. | Addl. 3mts. or Part thereof Rs. |
| ~ 20 miles | 3.60 | 2.60 | 2.30 | 1.30 |
| 20~ 50 miles | 5.20 | 4.20 | 3.10 | 2.10 |
| 50~ 70 miles | 8.00 | 7.00 | 4.50 | 3.50 |
| 70~120 miles | 9.40 | 8.40 | 5.20 | 4.20 |
| 120 miles~ | 13.60 | 12.60 | 7.30 | 6.30 |

Inside the Greater Colombo Area, all exchanges except the three step by step exchanges, i.e., Colombo Central, Maradana and Havelock Town, that are mutually connected by metallic circuits, are interconnected by the PCM system. The three remote controlled exchanges, i.e., Maharagama, Homogama and Padukka, are connected by radio PCM to Colombo Central, whereas all others are interconnected by cable PCM.

The radio PCM system mentioned above is to be replaced with the cable PCM system by the Project. Meanwhile, by CADS IV Plan, all step by step exchanges in the Greater Colombo Area are to be eliminated. Thus, in the Greater Colombo Area, the transmission routes will be unified to the cable PCM routes except in the section between Mt. Lavinia and Colombo Central exchanges.

The section between Biyagama and Colombo Central exchanges, though outside of the Project area, is scheduled to have the radio PCM system established. The section between Mt. Lavinia and Colombo Central exchanges will be provided with the optical fiber cable by the Project.

Figure 4-12 presents the main transmission routes throughout Sri Lanka after the completion of IDA Project. Figure 4-13 details the present and future transmission route formations in the Greater Colombo Area.

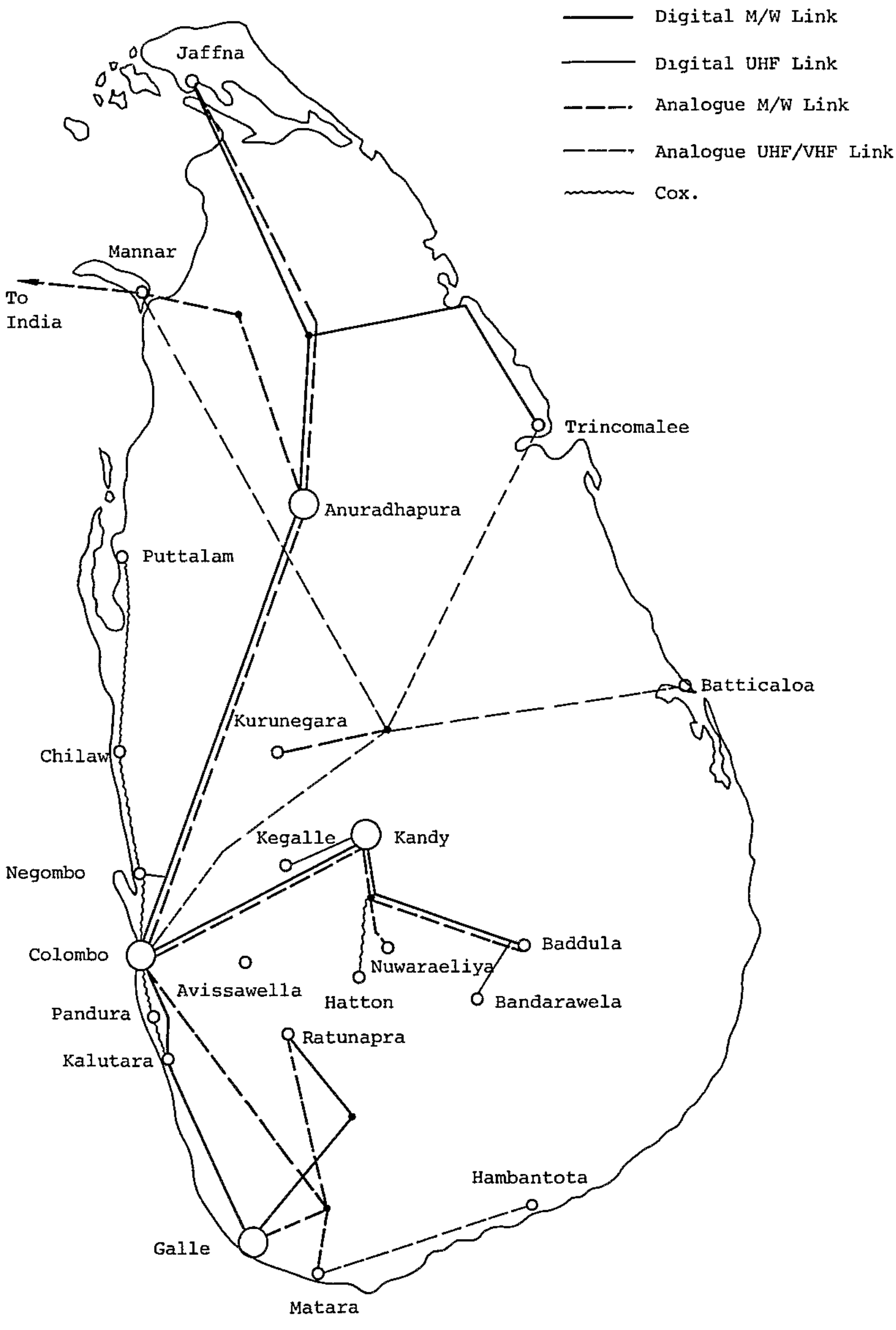



Figure 4-12 Main Transmission Link After IDA Project

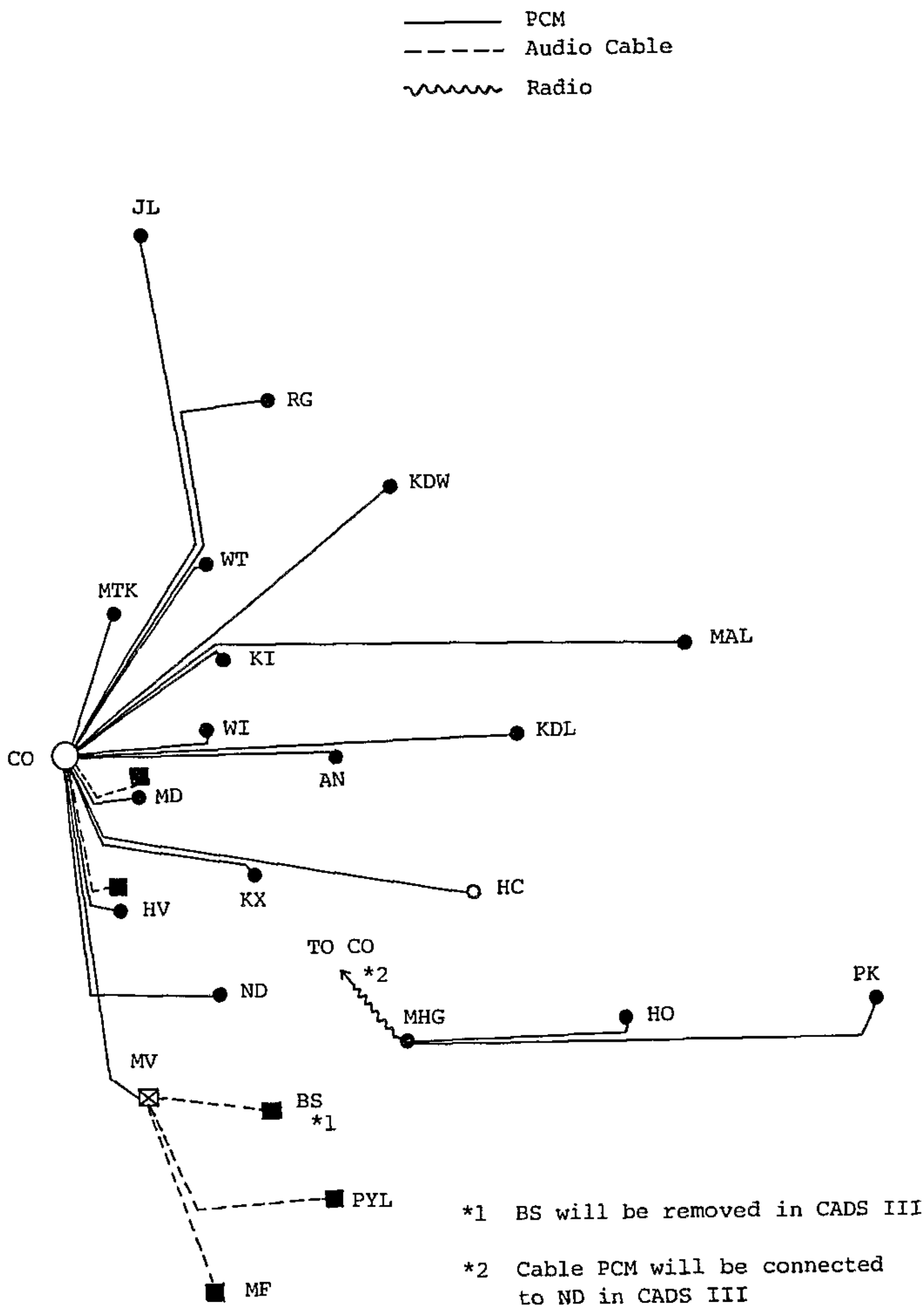



Figure 4-13 (1/2) Transmission Link at Present

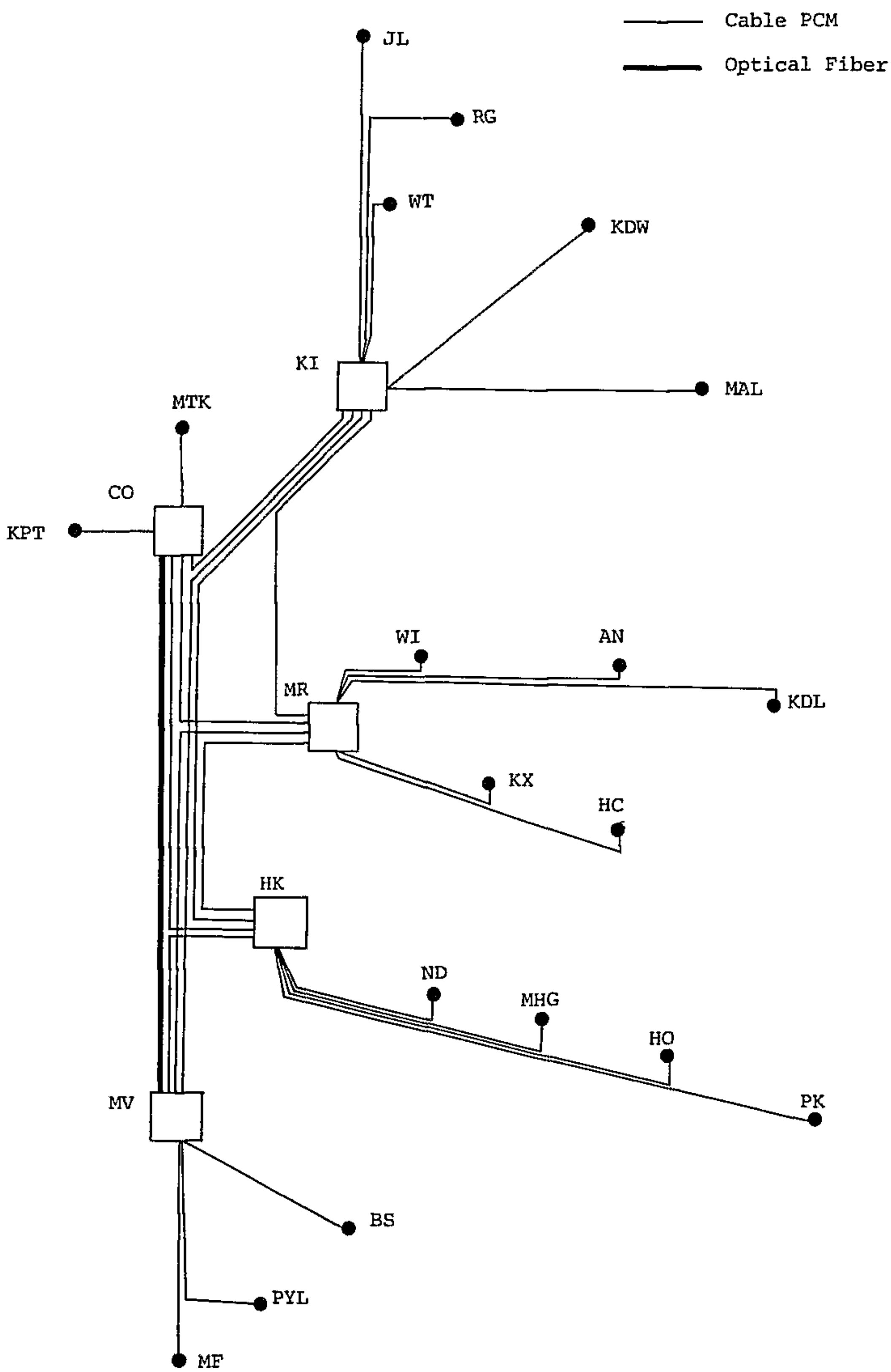



Figure 4-13 (2/2)  Transmission Link in Future

## 4-3-5 Signalling Plan

As of the present, signalling between step by step switches themselves and between step by step and other type of switches is by DP signal. For signalling between electronic switches themselves, between crossbar switches themselves and between electronic switch and cross bar switch, R2 (MFC) signal of CCITT standard is used.

The R2 signalling system is subdivided into the analogue version and digital version. Between digital switches themselves, the digital version R2 signalling is used. Between analogue switches themselves and between digital and analogue switches, the analogue version R2 signalling is used.

Toll connections are by the analogue system in almost all cases. Therefore, even between digital switches themselves, the analogue version R2 signalling is used.

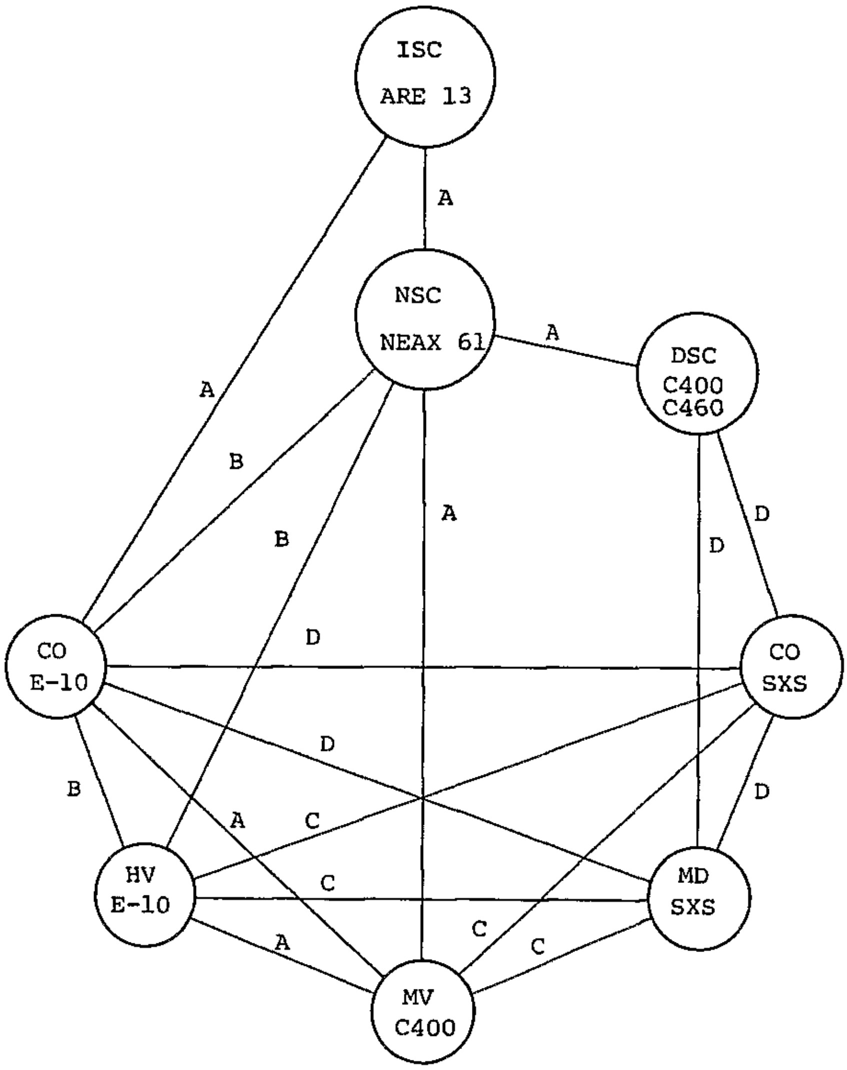
By the time of completion of CADS IV Plan, step by step exchanges will no longer exist in the Greater Colombo Area so that in the Area the R2 signalling system is to apply in all cases.

Figure 4-14 presents the signalling plan now used in the Greater Colombo Area. Table 4-8 (1/2) and Table 4-8 (2/2) clarify the meanings of MFC signals - forward and backword - adopted by SLTD of Sri Lanka.

## 4-3-6 Exchange Hierarchy

### (1) National Network

Exchange hierarchies in the national network are threefold. They are National Switching Center (NSC), District Switching Centers (DSC) and dependant exchanges.




A: R2 Analogue + E&M Signalling

B: R2 Digital + E&M Signalling

C: Decadic E&M Signalling

D: Decadic Loop Signalling

Figure 4-14 Signalling Plan for Greater Colombo as of CADS III

Table 4-8 (1/2) Meaning of R2 Forward Signals

| Signal No. | Group I | Group II |
|---|---|---|
| 1 | Digit 1 | Subscriber initiated call |
| 2 | " 2 | - |
| 3 | " 3 | - |
| 4 | " 4 | CCB. Sub. initiated call |
| 5 | " 5 | Operator initiated call |
| 6 | " 6 | - |
| 7 | " 7 | - |
| 8 | " 8 | - |
| 9 | " 9 | - |
| 10 | " 0 | - |
| 11 | Access to interception | Spare |
| 12 | Spare | " |
| 13 | Access to maintenance equipment | " |
| 14 | Spare | " |
| 15 | End of A-number | No information about the A-party's category |

Table 4-8 (2/2) Meaning of R2 Backward Signals

| Signal No. | Group A | Group B |
|---|---|---|
| 1 | Send next digit (N+1) | - |
| 2 | Send last but one digit (N-1) | - |
| 3 | Change to reception of B sig. | Subscriber engaged |
| 4 | Congestion | Congestion |
| 5 | Send category of A-party<br>Send number of A-party | NU Tone (Not used at present) |
| 6 | Set up speach conditions | Subscriber line free with metering |
| 7 | Send last digit but two (n-2) | Subscriber line free without metering |
| 8 | Send last digit but three (n-3) (not used at present) | - |
| 9 | - | - |
| 10 | - | - |
| 11 | - | - |
| 12 | - | - |
| 13 | - | - |
| 14 | - | - |
| 15 | - | - |

All DSCs are provided with trunk circuits to NSC, but each DSC is not provided with direct circuits to other DSCs.

All DSCs and NSC are capable of automatic operation. Seven of them are equipped with digital electronic switches, 16 with crossbar switches, and three with step by step switches. Two out of three step by step exchanges are not included in STD network.

The above network formation is scheduled to be modified by IDA Project.

NSC will remain unchanged. However, under the IDA Project, the whole country will be divided into four districts: Colombo, Kandy, Anuradhapura and Galle. In each of these four districts, Tertiary Switching Center (TSC) will be established, and each TSC will have Secondary Center (SC) under it. Each SC, without Primary Center (PC) under it, is connected directly to Dependant exchanges.

Figure 4-15 and Figure 4-16 respectively present the present and future phases of the national network.

(2) Greater Colombo Area Network

All exchanges in the Greater Colombo Area belong to Colombo DSC. They presently comprise five local exchanges, 18 RSUs and three suburban exchanges. The five local exchanges are interconnected by direct circuits. RSUs are accommodated in the master exchange established in Colombo Central Exchange.

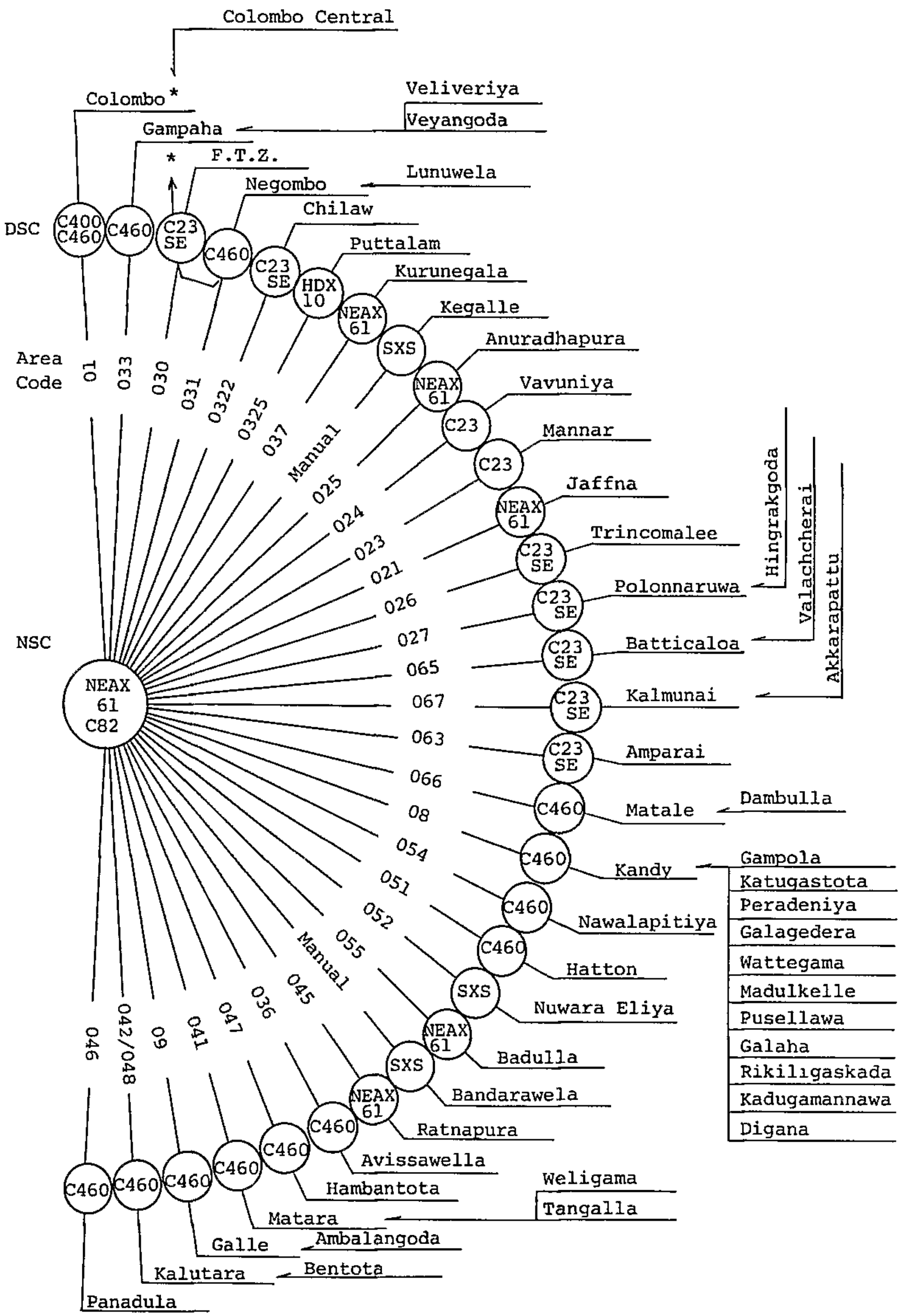



Figure 4-15 Present Routing Plan for STD Network

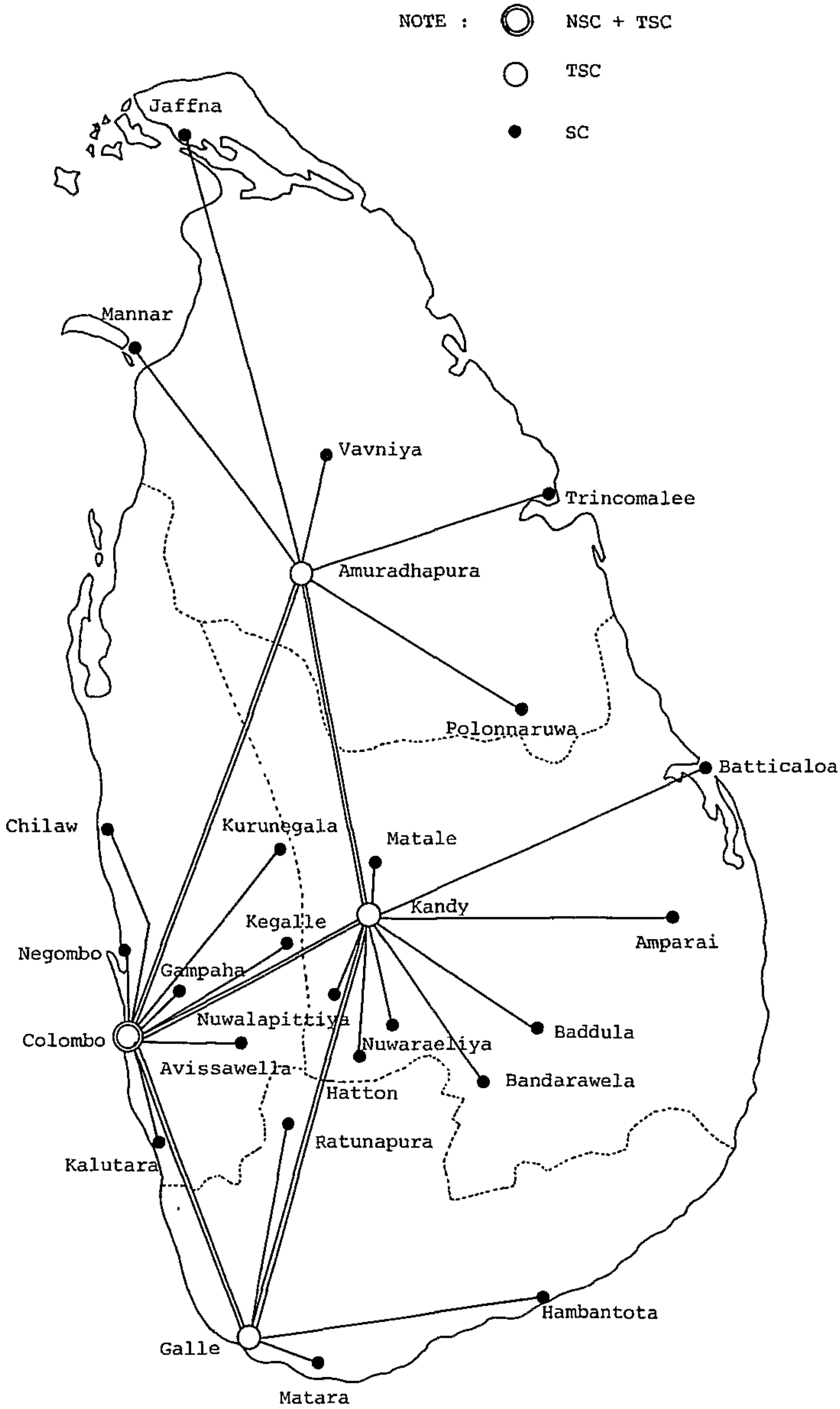



Figure 4-16 STD Network Routing Plan for After IDA Project

The three suburban exchanges, i.e., Boralesgamuwa, Piliyandala and Moratuwa, are presently outside of the Colombo multi-exchange area so that their calls to/from Colombo City subscribers are via Colombo DSC.

Toll calls from step by step exchanges in Colombo City are via DSC - NSC. Toll calls from electronic and crossbar exchanges in Colombo City are via NSC.

The relationship between master exchange and RSUs is to be changed because the master exchange will be established in Havelock Town Exchange by CADS III Plan. That is to say, RSUs will be divided into two groups, and the two groups will be accommodated in Colombo Central and Havelock Town exchanges, respectively. Further, by CADS IV Plan, the master exchange will be established in Maradana Exchange also and RSUs will then be divided into three groups.

In 1992 and after, two more master exchanges will be established, one in Mt. Lavinia Exchange and the other in Kelaniya Exchange. The local tandem exchange will be established in Colombo Central exchange office.

Figure 4-17 illustrates the stand alone exchange routing and Figure 4-18 the master exchange to RSU routing.

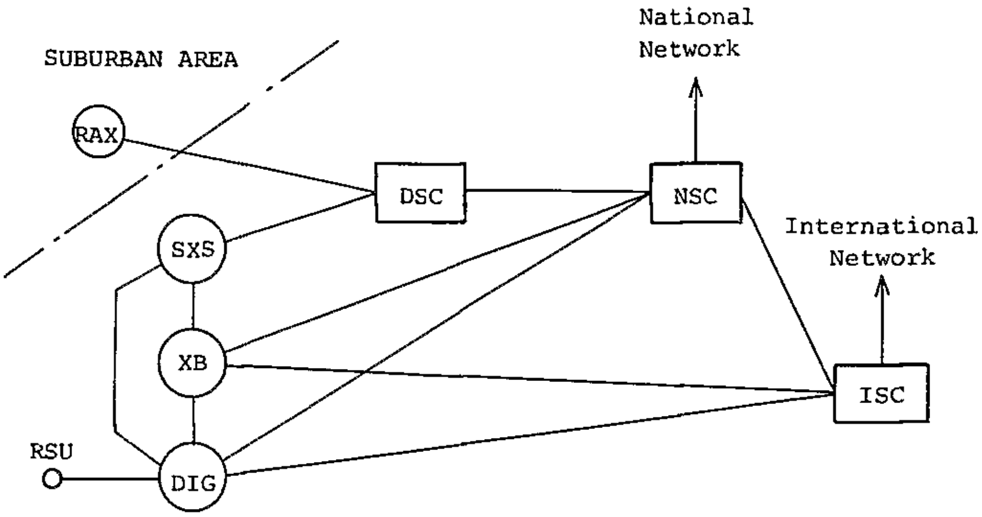



Figure 4-17 (1/2) Present Routing Plan for Independent Exchange

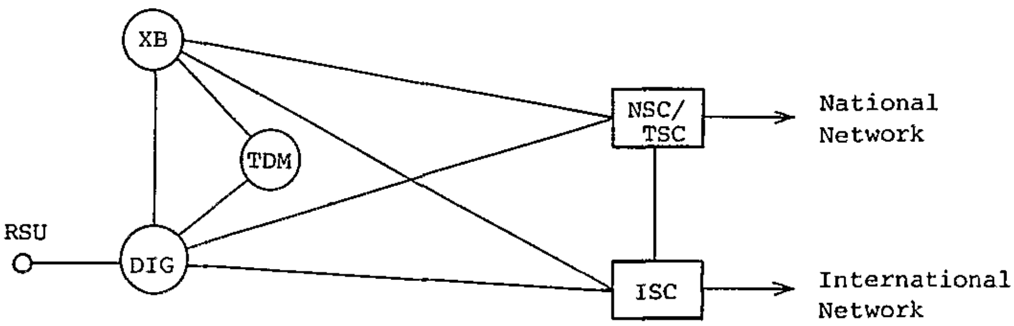



Figure 4-17 (2/2) Future Routing Plan for Independent Exchange

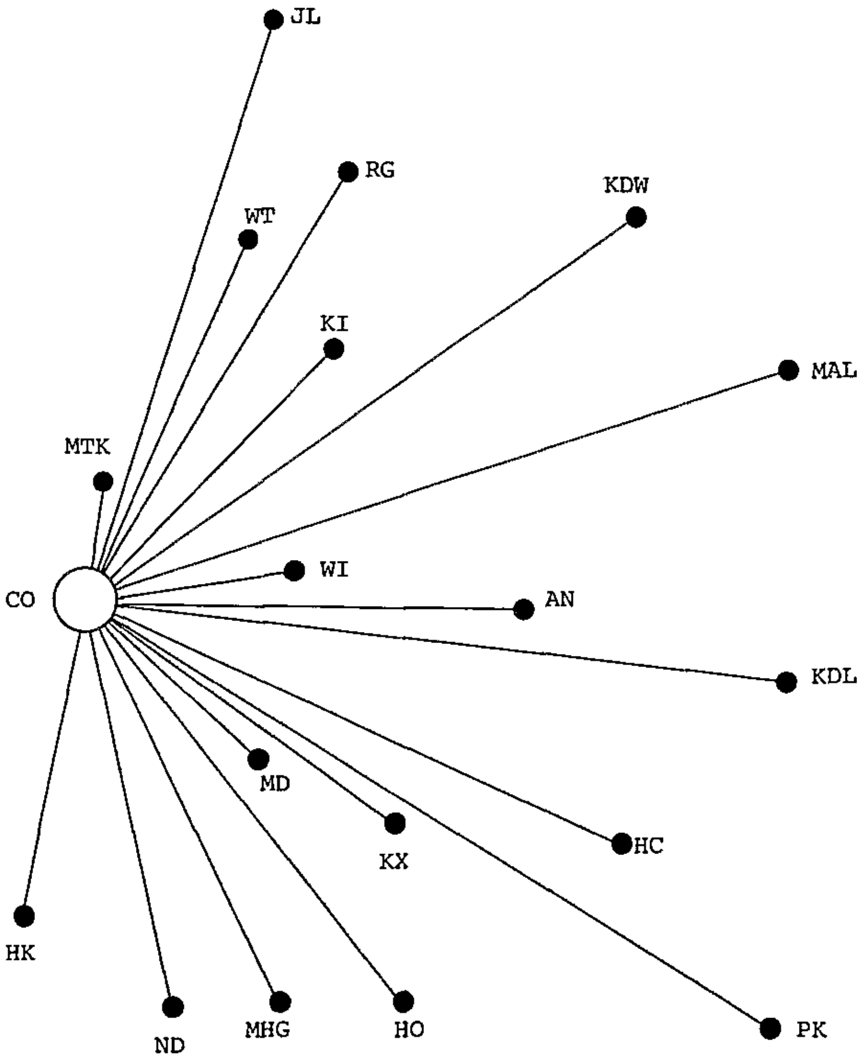



Figure 4-18 (1/3)  Remote Exchange Routing Plan (Existing)

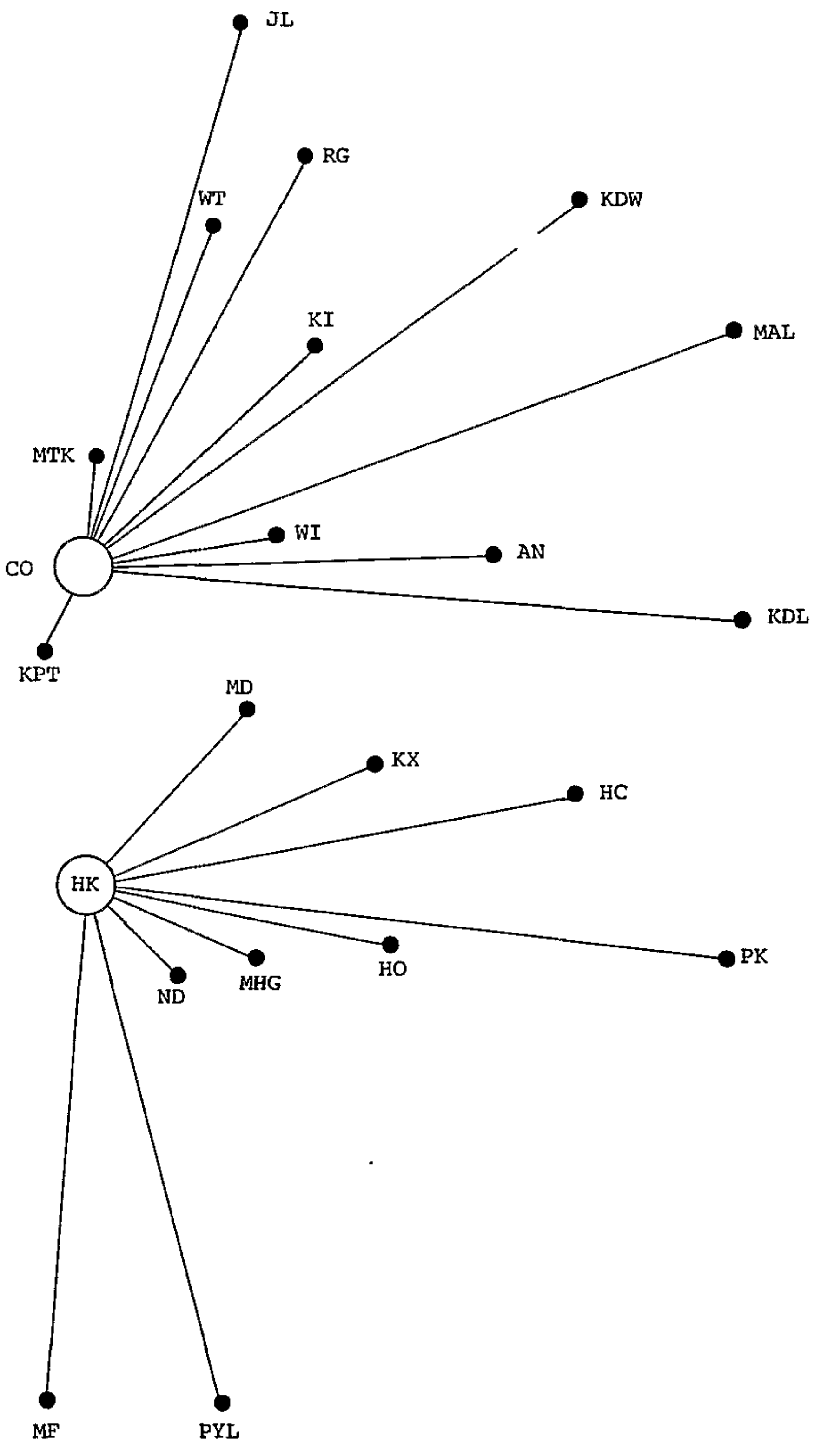



Figure 4-18 (2/3) Remote Exchange Routing Plan (CADS III)

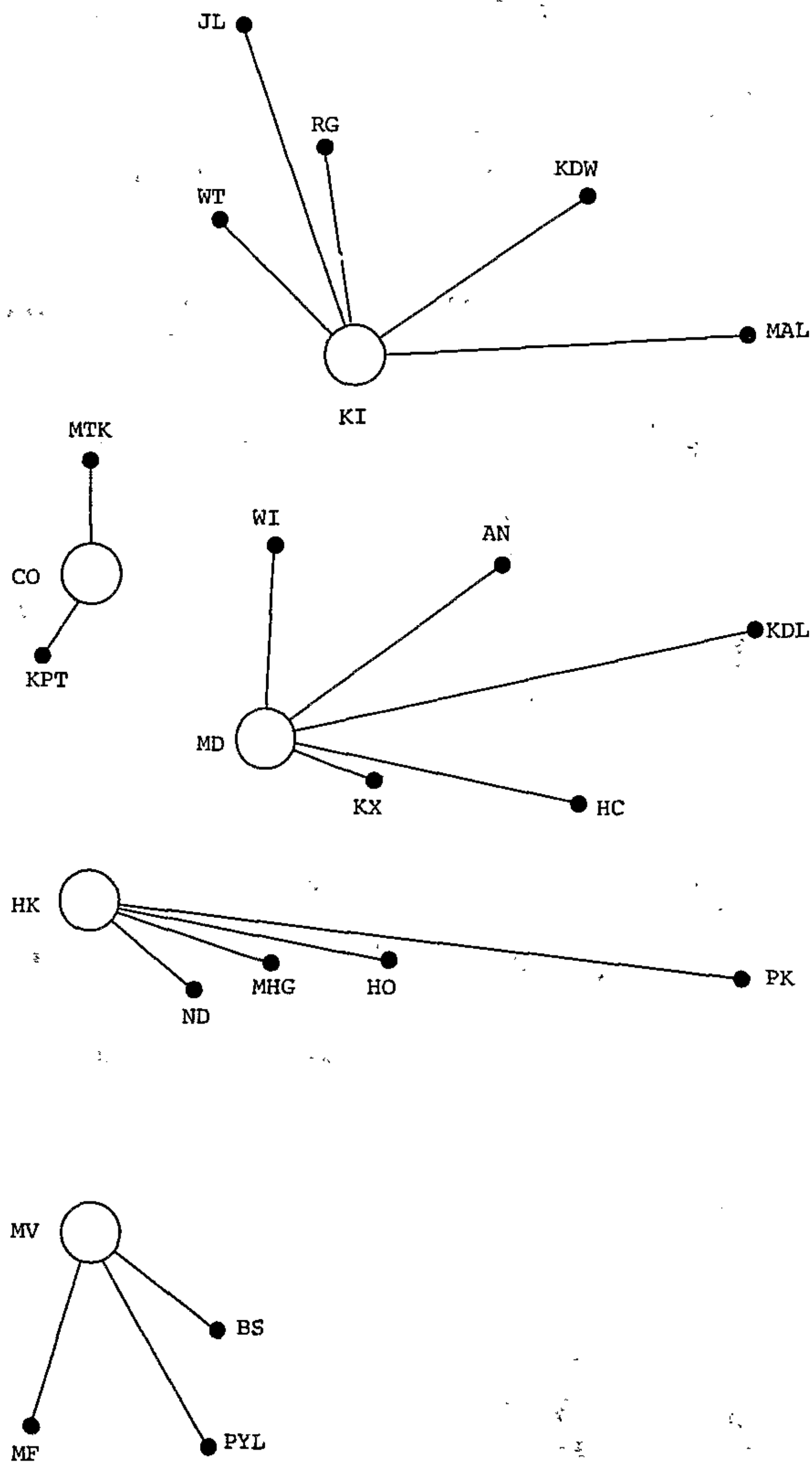



Figure 4-18 (3/3) Remote Exchange Routing Plan (After 1992)

# CHAPTER 5

# JUNCTION NETWORK PLAN

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CHAPTER 5 JUNCTION NETWORK PLAN

## 5-1 Traffic Forecast

Traffic forecast is indispensable for the planning or telecommunication network which will operate economically and which will provide effective service to the user.

Traffic forecast, this time, is made for the years 1987, 1992, 1997 and 2002. The purpose is to formulate the junction network expansion plan as part of the Project.

### 5-1-1 Traffic Data

Destination by destination traffic data as of February 1983 could be obtained. This data, however, does not cover STD, ISD and special service traffic from each exchange. Nor could time series data be procured.

The existing calling rates assumed from February 1983 traffic data appear in Table 5-1.

Some of exchanges listed in the table present high calling rates though located distant from the city center of Colombo. Cases can also be found wherein a much greater volume of traffic flows to specific exchanges than to others. All such exchanges have an extremely small number of subscribers.

This fact should be interpreted as an indication that the traffic characteristic of those exchanges mentioned above reflects the high calling rates of a small number of subscribers. Thus, in the future, when the number of subscribers will increase and such

Table 5-1 Traffic Data as of February 1983

| EX. | No. of Sub. | O/G Traffic (Erl.) | | | | | CR |
|---|---|---|---|---|---|---|---|
| | | LOC | STD | ISD | SPL | Total | |
| CO | 16,025 | 1,133.90 | 125.19 | 56.93 | 5.92 | 1,321.94 | 0.083 |
| MTK | 710 | 21.20 | 1.56 | 0.50 | 0.14 | 23.40 | 0.033 |
| KPT | - | - | - | - | - | - | - |
| KI | 712 | 23.47 | 4.33 | 0.18 | 0.15 | 28.13 | 0.040 |
| WT | 535 | 19.05 | 3.65 | 0.50 | 0.11 | 23.31 | 0.044 |
| RG | 135 | 7.47 | 1.87 | 0.13 | 0.04 | 9.51 | 0.070 |
| JL | 393 | 15.12 | 2.79 | 0.29 | 0.10 | 18.30 | 0.047 |
| MAL | 66 | 1.97 | 0.15 | 0.02 | 0.01 | 2.15 | 0.033 |
| KDW | 116 | 6.66 | 0.91 | 0.07 | 0.02 | 7.66 | 0.066 |
| MD | 6.447 | 323.32 | 32.30 | 6.10 | 2.10 | 363.82 | 0.056 |
| WI | 212 | 9.80 | 1.97 | 0.20 | 0.07 | 12.04 | 0.057 |
| AN | 111 | 4.18 | 0.45 | 0.08 | 0.01 | 4.72 | 0.043 |
| KDL | 58 | 2.73 | 0.25 | 0.03 | 0.02 | 3.03 | 0.052 |
| KX | 2,087 | 50.23 | 3.56 | 0.87 | 0.25 | 54.91 | 0.0263 |
| HC | 57 | 5.27 | 0.29 | 0.04 | 0.02 | 5.62 | 0.099 |
| HK | 9,052 | 368.31 | 49.84 | 6.50 | 3.08 | 427.73 | 0.047 |
| ND | 1,987 | 70.27 | 3.98 | 0.74 | 0.68 | 75.67 | 0.038 |
| MHG | 351 | 18.79 | 2.20 | 0.21 | 0.08 | 21.28 | 0.061 |
| HO | 113 | 5.40 | 0.52 | 0.10 | 0.10 | 6.12 | 0.054 |
| PK | 50 | 2.44 | 0.11 | 0.03 | 0.01 | 2.59 | 0.052 |
| MV | 5,397 | 135.31 | 33.18 | 4.05 | 1.35 | 173.89 | 0.032 |
| MF | 790 | 41.95 | 2.77 | 0.71 | 0.24 | 45.67 | 0.058 |
| PYL | 130 | 6.25 | 0.66 | 0.08 | 0.03 | 7.02 | 0.054 |
| BS | 89 | 3.83 | 0.45 | 0.06 | 0.02 | 4.36 | 0.049 |

Note: -STD traffic includes Traffic for Gampaha and Veliveliya.
-STD, ISD and SPL traffic is assumed being the same as I/C traffic.

high calling rate subscriber characteristic will weaken, the present traffic characteristic can least be considered to remain unaltered. This is why the traffic forecast is made by the method that is described later.

### 5-1-2 Originating Calling Rate Forecast

The originating calling rates vary according to the types of subscribers, social conditions and traffic rates, as well as the degree of telephone demand satisfied. For the originating calling rate forecast, several methods are available. They include the forecast from time series data and the forecast by means of comparison with data of other cities under similar conditions.

This time, however, the time series data was not available. Nor is the data of other similar cities useful because, in the present case, the demand is suppressed, causing the telephone dencity to remain at a low level. Thus, for the originating calling rate forecast, the undermentioned method is used.

To estimate the number of bussiness telephones and residence telephones on exchange by exchange basis, using for reference the demand investigation result for years concerned, and estimate the originating calling rate for each telephone category. Finally, to obtain the mean originating calling rate from the combined total of both telephone categories. The calculation formula follows:

$$C_m = \frac{(N_b \times C_b) + (N_r \times C_r)}{N_b + N_r}$$

where

$C_m$ : Mean Originating calling rate

$N_b$ : Number of business telephones

$N_r$ : Number of residence telephones

$C_b$ : Originating calling rate of business telephones

$C_r$ : Originating calling rate of residence telephones

For business telephones and residence telephones, the originating calling rates are assumed as under:

$C_b$ : 0.10

$C_r$ : 0.02

As the result of the foregoing calculation, the mean originating calling rate in the Greater Colombo Area as a whole can be known as under:

| Year | Mean Originating Calling Rate |
|---|---|
| 1983 | 0.05843 |
| 1987 | 0.06038 |
| 1992 | 0.05712 |
| 1997 | 0.05335 |
| 2002 | 0.05181 |

The exchange by exchange originating calling rate forecasts appear in Table 5-2.

5-1-3 Originating Traffic Composition

The originating traffic can be classified into major categories: local calls, toll calls, special service calls and international calls.

Table 5-2 Exchange by Exchange Originating Calling Rate Forecasts

| Ex. | Year | | | |
|---|---|---|---|---|
| | 1987 | 1992 | 1997 | 2002 |
| CO | 0.076 | 0.076 | 0.076 | 0.076 |
| MTK | 0.064 | 0.060 | 0.056 | 0.052 |
| KPT | 0.064 | 0.068 | 0.072 | 0.076 |
| KI | 0.052 | 0.044 | 0.036 | 0.036 |
| WT | 0.052 | 0.044 | 0.036 | 0.036 |
| RG | 0.044 | 0.036 | 0.028 | 0.028 |
| JL | 0.052 | 0.044 | 0.036 | 0.036 |
| MAL | 0.044 | 0.036 | 0.028 | 0.028 |
| KDW | 0.052 | 0.044 | 0.036 | 0.036 |
| MD | 0.068 | 0.064 | 0.060 | 0.056 |
| WI | 0.052 | 0.044 | 0.036 | 0.036 |
| AN | 0.052 | 0.044 | 0.036 | 0.036 |
| KDL | 0.044 | 0.036 | 0.028 | 0.028 |
| KX | 0.052 | 0.044 | 0.036 | 0.036 |
| HC | 0.044 | 0.036 | 0.028 | 0.028 |
| HK | 0.064 | 0.064 | 0.068 | 0.072 |
| ND | 0.036 | 0.044 | 0.048 | 0.048 |
| MHG | 0.052 | 0.044 | 0.036 | 0.036 |
| HO | 0.044 | 0.036 | 0.028 | 0.028 |
| PK | 0.044 | 0.036 | 0.028 | 0.028 |
| MV | 0.044 | 0.040 | 0.036 | 0.036 |
| MF | 0.052 | 0.044 | 0.036 | 0.036 |
| PYL | 0.044 | 0.036 | 0.028 | 0.028 |
| BS | 0.052 | 0.044 | 0.036 | 0.036 |

At the present stage, the toll call, international call and special service call ratios to the total originating traffic are:

| | STD | ISD | SPL |
|---|---|---|---|
| Average of all exchange in the Greater Colombo area | 10.33% | 2.97% | 0.55% |
| Colombo Central exchange | 10.87 | 4.94 | 0.51 |
| Average of all exchanges except Colombo Central exchange | 11.27 | 0.95 | 0.65 |

(1) Toll Call Ratio

The toll call ratio upgrades sharply as the national subscriber toll dialling network expands. However, the growth tempo will slacken once the network expansion culminates.

Data as of March 1982 shows that, when the Greater Colombo Area is excluded, 67.6% of subscribers throughout the country are incorporated in the subscriber toll dialling network. At present, the figure is considered to be at a level of 70%. When the remaining 30% are also incorporated in that network, the toll call ratio will improve by 43% over the present level.

In the previously quoted toll call ratios, no much difference is found between mean of all exchanges in the Greater Colombo area and Colombo Central share. Hence the consideration based on the former. The finding is that the existing toll call ratio of 10.33% will improve to somewhere around 15% once the network expansion culminates.

(2) International Call Ratio

The international call ratio differs broadly between Colombo Central and other exchanges. The difference can never be ignored.

The total quantity of international calls increases according as the number of subscribers increases. Nevertheless, the ratio to the total originating traffic is considered not to vary substantially. Thus, from the present data, the ratio is assumed to be 5% at Colombo Central and 1% at other exchanges.

(3) Special Service Call Ratio

Out of all the special service calls, those subject to traffic variation are directory assistance service and booking of delay service. Directory assistance service increases according as the subscribers in each exchange area increase and the subscriber toll dialling network expands. Booking of delay service decreases according to the subscriber toll dialling network expansion. Thus, on the assumption of no much traffic variation for the whole of special service calls, the call ratio is set at 0.55%.

(4) Originating Traffic Distribution

The originating traffic distributions to local calls, toll calls, international calls and special service calls, based on the foregoing study, are given in Table 5-3. For the number of subscribers whereby to calculate the traffic volume, the estimated demand size is used.

Table 5-3 (1/4) Originating Traffic Distribution to Each Service Category as of 1987

| EX. | No. of Sub. | Org. CR | Total OG (Erl.) | STD OG (Erl.) | ISD OG (Erl.) | SPL OG (Erl.) | LOC OG (Erl.) |
|---|---|---|---|---|---|---|---|
| CO 1 | 21,388 | 0.076 | 1,625.49 | 243.82 | 81.27 | 8.94 | 1,291.46 |
| CO 2 | 1,992 | 0.076 | 151.39 | 22.71 | 7.57 | 0.83 | 120.28 |
| MTK | 2,200 | 0.064 | 140.80 | 21.12 | 1.41 | 0.77 | 117.50 |
| KPT | 3,250 | 0.064 | 208.00 | 31.20 | 2.08 | 1.14 | 173.58 |
| KI | 2,320 | 0.052 | 120.64 | 18.10 | 1.21 | 0.66 | 100.67 |
| WT | 1,810 | 0.052 | 94.12 | 14.12 | 0.94 | 0.52 | 78.54 |
| RG | 530 | 0.044 | 23.32 | 3.50 | 0.23 | 0.13 | 22.61 |
| JL | 1,500 | 0.052 | 78.00 | 11.70 | 0.78 | 0.43 | 65.09 |
| MAL | 950 | 0.044 | 41.80 | 6.27 | 0.42 | 0.23 | 34.88 |
| KDW | 1,200 | 0.052 | 62.40 | 9.36 | 0.62 | 0.34 | 52.08 |
| MD | 10,660 | 0.068 | 724.88 | 108.73 | 7.25 | 3.99 | 604.91 |
| WI | 1,250 | 0.052 | 65.00 | 9.75 | 0.65 | 0.36 | 54.24 |
| AN | 870 | 0.052 | 45.24 | 6.79 | 0.45 | 0.25 | 37.75 |
| KDL | 500 | 0.044 | 22.00 | 3.30 | 0.22 | 0.12 | 18.36 |
| KX | 4,420 | 0.052 | 229.84 | 34.48 | 2.30 | 1.26 | 191.80 |
| HC | 430 | 0.044 | 18.92 | 2.84 | 0.19 | 0.10 | 15.79 |
| HK | 11,380 | 0.064 | 728.32 | 109.25 | 7.28 | 4.01 | 607.78 |
| ND | 5,410 | 0.036 | 194.76 | 29.21 | 1.95 | 1.07 | 162.53 |
| MHG | 2,060 | 0.052 | 107.12 | 16.07 | 1.07 | 0.59 | 89.39 |
| HO | 790 | 0.044 | 34.76 | 5.21 | 0.35 | 0.19 | 29.01 |
| PK | 410 | 0.044 | 18.04 | 2.71 | 0.18 | 0.10 | 15.05 |
| MV | 8,700 | 0.044 | 382.80 | 57.42 | 3.83 | 2.11 | 319.44 |
| MF | 3,320 | 0.052 | 172.64 | 25.90 | 1.73 | 0.95 | 144.06 |
| PYL | 530 | 0.044 | 23.32 | 3.50 | 0.23 | 0.13 | 19.46 |
| BS | 930 | 0.052 | 48.36 | 7.25 | 0.48 | 0.27 | 40.36 |

Table 5-3 (2/4) Originating Traffic Distribution to Each Service Category as of 1992

| EX. | No. of Sub. | Org. CR | Total OG (Erl.) | STD OG (Erl.) | ISD OG (Erl.) | SPL OG (Erl.) | LOC OG (Erl.) |
|---|---|---|---|---|---|---|---|
| CO 1 | 26,315 | 0.076 | 1,999.94 | 299.99 | 100.00 | 11.00 | 1,588.75 |
| CO 2 | 9,735 | 0.076 | 739.86 | 110.98 | 36.99 | 4.07 | 587.82 |
| MTK | 3,990 | 0.060 | 239.40 | 35.91 | 2.39 | 1.32 | 199.78 |
| KPT | 4,130 | 0.068 | 280.84 | 42.13 | 2.81 | 1.54 | 234.36 |
| KI | 3,840 | 0.044 | 168.96 | 25.34 | 1.69 | 0.93 | 141.00 |
| WT | 3,060 | 0.044 | 134.64 | 20.20 | 1.35 | 0.74 | 112.35 |
| RG | 1,060 | 0.036 | 38.16 | 5.72 | 0.38 | 0.21 | 31.85 |
| JL | 3,100 | 0.044 | 136.40 | 20.46 | 1.36 | 0.75 | 113.83 |
| MAL | 2,060 | 0.036 | 74.16 | 11.12 | 0.74 | 0.41 | 61.89 |
| KDW | 2,230 | 0.044 | 98.12 | 14.72 | 0.98 | 0.54 | 81.88 |
| MD | 14,400 | 0.064 | 921.60 | 138.24 | 9.22 | 5.07 | 769.07 |
| WI | 2,350 | 0.044 | 103.40 | 15.51 | 1.03 | 0.57 | 86.29 |
| AN | 1,510 | 0.044 | 66.44 | 9.97 | 0.66 | 0.37 | 55.44 |
| KDL | 1,030 | 0.036 | 37.08 | 5.56 | 0.37 | 0.20 | 30.95 |
| KX | 6,700 | 0.044 | 294.80 | 44.22 | 2.95 | 1.62 | 246.01 |
| HC | 920 | 0.036 | 33.12 | 4.97 | 0.33 | 0.18 | 27.64 |
| HK | 15,640 | 0.064 | 1,000.96 | 150.14 | 10.01 | 5.51 | 835.30 |
| ND | 8,450 | 0.044 | 371.80 | 55.77 | 3.72 | 2.04 | 310.27 |
| MHG | 3,510 | 0.044 | 154.44 | 23.17 | 1.54 | 0.85 | 128.88 |
| HO | 1,770 | 0.036 | 63.72 | 9.56 | 0.64 | 0.35 | 53.17 |
| PK | 1,040 | 0.036 | 37.44 | 5.62 | 0.37 | 0.21 | 31.24 |
| MV 1 | 12,000 | 0.040 | 480.00 | 72.00 | 4.80 | 2.64 | 400.56 |
| MV 2 | 1,760 | 0.040 | 70.40 | 10.56 | 0.70 | 0.39 | 58.75 |
| MF | 5,080 | 0.044 | 223.52 | 33.53 | 2.24 | 1.23 | 186.52 |
| PYL | 1,120 | 0.036 | 40.32 | 6.05 | 0.40 | 0.22 | 33.65 |
| BS | 1,200 | 0.044 | 52.80 | 7.92 | 0.53 | 0.29 | 44.06 |

Table 5-3 (3/4) Originating Traffic Distribution to Each Exchange Category as of 1997

| EX. | No. of Sub. | Org. CR | Total OG (Erl.) | STD OG (Erl.) | ISD OG (Erl.) | SPL OG (Erl.) | LOC OG (Erl.) |
|---|---|---|---|---|---|---|---|
| CO 1 | 26,315 | 0.076 | 1,999.94 | 299.99 | 100.00 | 11.00 | 1,588.95 |
| CO 2 | 15,742 | 0.076 | 1,196.39 | 179.46 | 59.82 | 6.58 | 950.53 |
| CO 3 | 7,753 | 0.076 | 589.23 | 88.38 | 29.46 | 3.24 | 468.15 |
| MTK | 6,700 | 0.056 | 375.20 | 56.28 | 3.75 | 2.06 | 313.11 |
| KPT | 5,950 | 0.072 | 428.40 | 64.26 | 4.28 | 2.36 | 357.50 |
| KI | 6,300 | 0.036 | 226.80 | 34.02 | 2.27 | 1.25 | 189.26 |
| WT | 4,900 | 0.036 | 176.40 | 26.46 | 1.76 | 0.97 | 147.21 |
| RG | 1,820 | 0.028 | 50.96 | 7.64 | 0.51 | 0.28 | 42.53 |
| JL | 5,220 | 0.036 | 187.92 | 28.19 | 1.88 | 1.03 | 156.82 |
| MAL | 4,000 | 0.028 | 112.00 | 16.80 | 1.12 | 0.62 | 93.46 |
| KDW | 4,320 | 0.036 | 155.52 | 23.33 | 1.56 | 0.86 | 129.77 |
| MD | 20,610 | 0.060 | 1,236.60 | 185.49 | 12.37 | 6.80 | 1,031.94 |
| WI | 4,110 | 0.036 | 147.96 | 22.19 | 1.48 | 0.81 | 123.48 |
| AN | 3,170 | 0.036 | 114.12 | 17.12 | 1.14 | 0.63 | 95.23 |
| KDL | 1,880 | 0.028 | 52.64 | 7.90 | 0.53 | 0.29 | 43.92 |
| KX | 10,520 | 0.036 | 378.72 | 56.81 | 3.79 | 2.08 | 316.04 |
| HC | 1,730 | 0.028 | 48.44 | 7.27 | 0.48 | 0.27 | 40.42 |
| HK 1 | 15,765 | 0.068 | 1,072.02 | 160.80 | 10.72 | 5.90 | 894.60 |
| HK 2 | 6,605 | 0.068 | 449.14 | 67.37 | 4.49 | 2.47 | 374.81 |
| ND | 12,620 | 0.048 | 605.76 | 90.86 | 6.06 | 3.33 | 505.51 |
| MHG | 5,450 | 0.036 | 196.20 | 29.43 | 1.96 | 1.08 | 163.73 |
| HO | 2,820 | 0.028 | 78.96 | 11.84 | 0.79 | 0.43 | 65.90 |
| PK | 1,680 | 0.028 | 47.04 | 7.06 | 0.47 | 0.26 | 39.25 |
| MV 1 | 12,000 | 0.036 | 420.00 | 64.80 | 4.32 | 2.38 | 360.50 |
| MV 2 | 6,680 | 0.036 | 240.48 | 36.07 | 2.40 | 1.32 | 200.69 |
| MF | 8,340 | 0.036 | 300.24 | 45.04 | 3.00 | 1.65 | 250.55 |
| PYL | 1,650 | 0.028 | 46.20 | 6.93 | 0.46 | 0.25 | 38.50 |
| BS | 1,550 | 0.036 | 55.80 | 8.37 | 0.56 | 0.31 | 46.56 |

Table 5-3 (4/4) Originating Traffic Distribution to Each Exchange Category as of 2002

| EX. | No. of Sub. | Org. CR | Total OG (Erl.) | STD OG (Erl.) | ISD OG (Erl.) | SPL OG (Erl.) | LOC OG (Erl.) |
|---|---|---|---|---|---|---|---|
| CO 1 | 26,315 | 0.076 | 1,999.94 | 299.99 | 100.00 | 11.00 | 1,588.95 |
| CO 2 | 12,725 | 0.076 | 967.10 | 145.07 | 48.36 | 5.32 | 768.35 |
| CO 3 | 26,315 | 0.076 | 1,999.94 | 299.99 | 100.00 | 11.00 | 1,588.95 |
| CO 4 | 3,345 | 0.076 | 254.22 | 38.13 | 12.71 | 1.40 | 201.98 |
| MTK | 9,120 | 0.052 | 474.24 | 71.14 | 4.74 | 2.61 | 395.75 |
| KPT | 7,350 | 0.076 | 558.60 | 83.79 | 5.59 | 3.07 | 446.15 |
| KI | 10,190 | 0.036 | 366.84 | 55.03 | 3.67 | 2.02 | 306.12 |
| WT | 8,290 | 0.036 | 298.44 | 44.77 | 2.98 | 1.64 | 249.05 |
| RG | 3,440 | 0.028 | 96.32 | 14.45 | 0.96 | 0.53 | 80.38 |
| JL | 9,790 | 0.036 | 352.44 | 52.87 | 3.52 | 1.94 | 294.11 |
| MAL | 7,890 | 0.028 | 220.92 | 33.14 | 2.21 | 1.22 | 184.35 |
| KDW | 8,000 | 0.036 | 288.00 | 43.20 | 2.88 | 1.58 | 240.34 |
| MD 1 | 13,667 | 0.056 | 765.35 | 114.80 | 7.65 | 4.21 | 638.69 |
| MD 2 | 15,243 | 0.056 | 853.61 | 128.04 | 8.54 | 4.69 | 712.34 |
| WI | 7,330 | 0.036 | 263.88 | 39.58 | 2.64 | 1.45 | 220.21 |
| AN | 5,700 | 0.036 | 205.20 | 30.78 | 2.05 | 1.13 | 171.24 |
| KDL | 3,640 | 0.028 | 101.92 | 15.29 | 1.02 | 0.56 | 85.05 |
| KX | 15,860 | 0.036 | 570.96 | 85.64 | 5.71 | 3.14 | 476.47 |
| HC | 3,310 | 0.028 | 92.68 | 13.90 | 0.93 | 0.51 | 77.34 |
| HK 1 | 9,578 | 0.072 | 689.62 | 103.44 | 6.90 | 3.79 | 575.49 |
| HK 2 | 22,002 | 0.072 | 1,584.14 | 237.62 | 15.84 | 8.71 | 1,321.97 |
| ND | 15,310 | 0.048 | 734.88 | 110.23 | 7.35 | 4.04 | 613.26 |
| MHG | 8,970 | 0.036 | 322.92 | 48.44 | 3.23 | 1.78 | 269.47 |
| HO | 5,520 | 0.028 | 154.56 | 23.18 | 1.55 | 0.85 | 128.98 |
| PK | 3,500 | 0.028 | 98.00 | 14.70 | 0.98 | 0.54 | 81.78 |
| MV 1 | 12,000 | 0.036 | 432.00 | 64.80 | 4.32 | 2.38 | 360.50 |
| MV 2 | 14,210 | 0.036 | 511.56 | 76.73 | 5.12 | 2.81 | 426.90 |
| MF | 12,790 | 0.036 | 460.44 | 69.07 | 4.60 | 2.53 | 384.24 |
| PYL | 3,060 | 0.028 | 85.68 | 12.85 | 0.86 | 0.47 | 71.50 |
| BS | 2,040 | 0.036 | 73.44 | 11.02 | 0.73 | 0.40 | 61.29 |

Therefore, even in the event of delay in further switching equipment installation and subscriber cable network expansion work of the exchanges (except 7 exchanges and Kollupitiya exchange) not listed for survey, this time, the consequent calling rate growth per subscriber can be put under control of the estimation.

5-1-4 Local Traffic Distribution

The traffic volume between two exchanges in the multi-exchange area is inversely proportional to the distance between the two exchanges and is in proportion to interest of community factor or, more precisely, economic and social proximity between both exchange areas.

The calculation formula adopted, this time, is the gravity model formula described in CCITT GAS-5 Manual. It is as under:

$$A_{ij} = A_i \cdot \frac{\dfrac{A_i \cdot A_j}{D_{ij}^{\,r}}}{\dfrac{A_i \cdot A_1}{D_{i1}^{\,r}} + \dfrac{A_i \cdot A_2}{D_{i2}^{\,r}} + \cdots \dfrac{A_i \cdot A_j}{D_{ij}^{\,r}} + \cdots \dfrac{A_i \cdot A_n}{D_{in}^{\,r}}}$$

$$= A_i \cdot \frac{\dfrac{A_j}{D_{ij}^{\,r}}}{\dfrac{A_1}{D_{i1}^{\,r}} + \dfrac{A_2}{D_{i2}^{\,r}} + \cdots \dfrac{A_j}{D_{ij}^{\,r}} + \cdots \dfrac{A_n}{D_{in}^{\,r}}}$$

where

$A_{ij}$ : Traffic volume from Exchange i to Exchange j

$A_n$ : Total originating traffic at Exchange n

$D_{ij}$ : Distance between Exchange i and Exchange j

r : Interest of community factor

Interest of community factor, r, should, in principle, be determined in accordance with the actual traffic flow. The existing traffic flow is given in Table 5-4.

However, especially at small exchanges, the present traffic flow may be strongly influenced by the high calling rate of a limited number of subscribers. Thus, as the commonly acceptable values, 0.05 is allocated to Colombo Central where interest of community factor is considered to be the biggest, 0.01-0.02 to other areas with relatively brisk social activities, and 0.005 to suburb areas. All these values must be reviewed and revised when the traffic flow becomes stable at each expansion stage.

Table 5-5 presents the possible traffic flow in the future.

## 5-2 Circuit Grouping

### 5-2-1 Number of Circuits Required

(1) Between Master Exchanges

Based on the inter-exchange traffic estimated in the preceding section 5-1, the calculation is made for the number of junction circuits required.

Table 5-4 Existing Traffic Flow (as of 1983)

| FROM \ TO | CO | MTK | KI | WT | RG | JL | MAL | KDW | MD | WI | AN | KDL | KX | HC | HK | ND | MHG | HO | PK | MV | MF | PYL | BS | GQ | VR | STD | SPL | ISD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | 551.02 | 9.23 | 11.44 | 9.08 | 4.01 | 9.13 | .72 | 1.65 | 173.50 | 4.93 | 1.95 | 1.30 | 16.76 | 1.38 | 176.50 | 20.65 | 6.27 | 1.91 | 1,01 | 110.77 | 17.00 | 2.19 | 1.50 | 11.48 | .51 | – | – | – |
| MTK | 8.20 | 1.92 | .22 | .16 | .10 | .03 | – | .01 | 4.40 | .40 | .01 | – | .03 | – | 3.44 | .69 | – | – | – | 1.16 | .38 | .05 | – | – | – | – | – | – |
| KI | 6.67 | – | 3.16 | .47 | .41 | .93 | – | .36 | .70 | .17 | .05 | – | 3.01 | – | 3.65 | .35 | .51 | .03 | .01 | 2.29 | .40 | .18 | .12 | 1.69 | – | – | – | – |
| WT | 6.50 | .05 | .90 | 2.05 | .20 | .46 | – | .01 | 6.60 | .27 | .04 | – | .11 | – | .95 | .18 | .02 | – | – | .60 | .10 | .01 | – | .82 | – | – | – | – |
| RG | 2.86 | – | .27 | .25 | 1.00 | .20 | – | .36 | 1.50 | – | – | – | .04 | – | .52 | .05 | .02 | – | – | .33 | .06 | .01 | – | 1.50 | – | – | – | – |
| JL | 8.78 | .07 | .22 | .23 | .09 | 1.86 | – | .03 | 2.20 | .04 | – | – | .32 | – | .73 | – | – | .01 | – | .46 | .08 | – | – | 2.37 | – | – | – | – |
| MAL | .60 | .05 | .11 | – | – | – | .33 | – | .40 | – | – | .01 | .12 | – | .15 | .12 | – | – | – | .08 | – | – | – | – | .01 | – | – | – |
| KDW | .95 | .10 | .39 | .01 | .92 | 1.10 | – | .70 | 1.00 | – | – | – | .10 | – | .80 | .20 | – | .09 | – | .30 | – | – | – | 1.78 | – | – | – | – |
| MD | 148.14 | 4.05 | 3.10 | 3.46 | .58 | 1.32 | .11 | .34 | 88.50 | 1.61 | .46 | .20 | 8.88 | .23 | 29.58 | 8.16 | 1.27 | .68 | .09 | 18.56 | 3.26 | .44 | .30 | 5.38 | .08 | – | – | – |
| WI | 1.86 | .60 | .40 | .21 | – | .20 | .01 | .05 | 2.70 | 1.30 | .07 | .03 | .11 | .03 | 1.28 | – | – | – | – | .81 | .14 | – | – | – | .01 |  |  |  |
| AN | .95 | – | .05 | .14 | – | – | – | – | .50 | .10 | 1.04 | – | .65 | – | .21 | .10 | – | .29 | – | .13 | .02 | – | – | – | – | – | – | – |
| KDL | 1.16 | – | .30 | – | – | .15 | – | .04 | – | – | – | .60 | – | .04 | .40 | – | – | .04 | – | – | – | – | – | – | – | – | – | – |
| KX | 18.41 | 1.25 | .17 | .11 | .08 | .18 | .30 | .08 | 9.00 | .43 | – | .53 | 7.64 | .63 | 4.94 | 1.60 | .51 | .36 | .07 | 3.10 | .54 | .18 | .12 | .33 | .21 | – | – | – |
| HC | 1.10 | .30 | .30 | – | .10 | .15 | – | – | .60 | – | .01 | .25 | .11 | .71 | .40 | .15 | .40 | .47 | .03 | .13 | .02 | – | .04 | – | – | – | – | – |
| HK | 148.56 | 4.66 | 2.78 | 1.86 | .37 | .84 | .10 | .22 | 63.30 | 1.94 | .27 | .18 | 4.45 | .22 | 100.14 | 13.79 | .68 | .38 | .31 | 17.86 | 5.00 | .24 | .16 | 3.52 | .07 | – | – | – |
| ND | 20.00 | 1.87 | .98 | .11 | .01 | .03 | – | .08 | 5.80 | .13 | .05 | – | 2.88 | – | 16.47 | 7.91 | 1.02 | .20 | .07 | 10.34 | 1.82 | .26 | .24 | .58 | – | – | – | – |
| MHG | 2.86 | .09 | .03 | .18 | – | – | – | – | 2.50 | – | – | – | .27 | – | 5.55 | 1.08 | 1.73 | .30 | .11 | 3.48 | .61 | – | – | – | – | – | – | – |
| HO | .75 | – | .26 | – | – | – | – | – | .20 | – | – | .01 | .07 | .01 | 1.55 | – | .15 | 1.21 | – | .97 | .17 | .05 | – | – | – | – | – | – |
| PK | .65 | – | .15 | .10 | – | – | – | – | .35 | .02 | – | – | .15 | .02 | .25 | – | .10 | .05 | .54 | – | – | .04 | .02 | – | – | – | – | – |
| MV | 15.77 | 1.43 | 1.12 | .97 | – | – | .03 | .12 | 13.90 | .95 | – | .06 | 2.39 | .07 | 28.46 | 3.02 | .28 | .15 | – | 62.85 | 3.14 | .36 | .24 | – | .02 | – | – | – |
| MF | 15.20 | .60 | .25 | – | – | – | .04 | .12 | 6.00 | – | – | – | .70 | – | 3.50 | 1.00 | – | – | – | 3.50 | 11.04 | – | – | – | .03 | – | – | – |
| PYL | 1.50 | – | – | – | – | – | .01 | .01 | 1.00 | – | – | – | .25 | – | 1.00 | .25 | .10 | – | – | 1.00 | .50 | .61 | .02 | – | – | – | – | – |
| BS | 1.13 | – | – | – | – | – | – | .01 | .40 | – | – | – | – | – | .60 | .30 | – | – | – | .60 | – | .30 | .49 | – | – | – | – | – |
| GQ | 10.00 | .20 | 1.00 | 1.00 | 1.00 | .50 | – | .30 | 2.50 | .50 | – | – | .50 | – | 1.50 | .50 | – | – | – | .70 | .10 | – | – | 4.00 | .05 | – | – | – |
| VR | .35 | – | – | – | – | – | .01 | .02 | .20 | – | – | – | .01 | – | .10 | .01 | – | – | – | .10 | – | – | – | .04 | .24 | – | – | – |
| STD | 114.84 | 1.36 | 3.33 | 2.65 | .87 | 2.29 | .14 | .59 | 29.60 | 1.47 | .45 | .25 | 3.05 | .29 | 48.24 | 3.47 | 2.20 | .52 | .11 | 32.38 | 2.67 | .66 | .45 | 4.13 | .15 | – | – | – |
| SPL | 5.92 | .14 | .15 | .11 | .04 | .10 | .01 | .02 | 2.10 | .07 | .01 | .02 | .25 | .02 | 3.08 | .68 | .08 | .10 | .01 | 1.35 | .24 | .03 | .02 | .17 | .01 | – | – | – |
| ISD | 56.93 | .50 | .18 | .50 | .13 | .29 | .02 | .07 | 6.10 | .20 | .08 | .03 | .87 | .04 | 6.50 | .74 | .21 | .10 | .03 | 4.05 | .71 | .08 | .06 | .52 | .02 |  |  |  |

Table 5-5 (1/4) Traffic Flow as of 1987

| FROM \ TO | CO. 1 | CO 2 | CO. 3 | CO. 4 | MTK | KPT | KI | WT | RG | JL | MAL | KDW | MD. 1 | MD. 2 | WI | AN | KDL | KX | HC | HK 1 | HK 2 | ND | MHG | HO | PK | MV. 1 | MV. 2 | MF | PYL | BS | | STD | ISD | SPL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO. 1 | 478.03 | 44.52 | | | 30.01 | 44.56 | 26 15 | 20 37 | 5.85 | 16 82 | 9.00 | 13.47 | 155.17 | | 14 00 | 9.78 | 4.75 | 49.77 | 4 08 | 154 04 | | 42 13 | 23 12 | 7 49 | 3.88 | 81 76 | | 37 21 | 5 03 | 10 44 | | 243.82 | 81.27 | 8.94 | 1,625.46 |
| CO 2 | 44.52 | 4 15 | | | 2 80 | 4 15 | 2 44 | 1 90 | 0.54 | 1.57 | 0 84 | 1.25 | 14 45 | | 1.30 | 0 91 | 0 44 | 4 64 | 0 38 | 14 35 | | 3 92 | 2 15 | 0 70 | 0 36 | 7 61 | | 3 47 | 0 47 | 0 97 | | 22.71 | 7 57 | 0 83 | 151.39 |
| CO. 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CO 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MTK | 33.36 | 3.11 | | | 3.72 | 4.62 | 2.76 | 2 15 | 0.62 | 1.77 | 0.95 | 1 42 | 16 17 | | 1.47 | 1.03 | 0 50 | 5.23 | 0 43 | 16.06 | | 4 42 | 2 43 | 0.79 | 0 41 | 8 57 | | 3 91 | 0 53 | 1 10 | | 21 12 | 1 41 | 0 77 | 140.83 |
| KPT | 49 33 | 4 59 | | | 4.56 | 8.01 | 4 01 | 3 12 | 0.90 | 2.58 | 1.38 | 2 07 | 23 94 | | 2.15 | 1 50 | 0 73 | 7.65 | 0 63 | 23 98 | | 6 48 | 3 55 | 1 15 | 0 60 | 12 58 | | 5 71 | 0 77 | 1.60 | | 31 20 | 2 08 | 1 14 | 207 99 |
| KI | 28.25 | 2.63 | | | 2 74 | 3 99 | 2.49 | 1.86 | 0 53 | 1.53 | 0.82 | 1 23 | 13 98 | | 1.28 | 0 89 | 0 43 | 4 54 | 0 37 | 13.90 | | 3 83 | 2.11 | 0.68 | 0 35 | 7 43 | | 3 39 | 0.46 | 0.95 | | 18.10 | 1.21 | 0 66 | 120.63 |
| WT | 21 86 | 2 04 | | | 2.14 | 3.11 | 1 88 | 1 53 | 0 42 | 1 21 | 0 65 | 0.97 | 10 90 | | 1.00 | 0 70 | 0.34 | 3 56 | 0 29 | 10 86 | | 3 01 | 1 65 | 0.54 | 0 28 | 5 83 | | 2.66 | 0 36 | 0.75 | | 14 12 | 0.94 | 0 52 | 94 12 |
| RG | 6.21 | 0.58 | | | 0.61 | 0 90 | 0.54 | 0 43 | 0.13 | 0 35 | 0.19 | 0 28 | 3 14 | | 0.29 | 0 20 | 0 10 | 1 04 | 0 09 | 3 14 | | 0.88 | 0 48 | 0.16 | 0 08 | 1.69 | | 0 77 | 0.10 | 0.22 | | 3 50 | 0.23 | 0.13 | 26 46 |
| JL | 17 77 | 1 65 | | | 1 77 | 2.59 | 1 57 | 1 23 | 0.35 | 1.07 | 0 54 | 0 81 | 9 05 | | 0 84 | 0 59 | 0 29 | 2 99 | 0 25 | 9 05 | | 2 53 | 1 39 | 0.45 | 0.23 | 4.89 | | 2 24 | 0 30 | 0 63 | | 11.70 | 0.78 | 0 43 | 77 98 |
| MAL | 9.45 | 0.88 | | | 0.94 | 1 39 | 0 85 | 0.66 | 0 19 | 0 55 | 0 31 | 0 44 | 4.86 | | 0 45 | 0 32 | 0 15 | 1.61 | 0.13 | 4 88 | | 1.36 | 0 75 | 0.24 | 0 13 | 2 64 | | 1 21 | 0 16 | 0 34 | | 6 27 | 0.42 | 0 23 | 41 81 |
| KDW | 14.27 | 1.33 | | | 1.41 | 2.07 | 1.25 | 0.98 | 0.28 | 0.81 | 0 43 | 0 68 | 7 27 | | 0 67 | 0 47 | 0.23 | 2 38 | 0 20 | 7.24 | | 2 02 | 1.11 | 0 36 | 0 19 | 3 90 | | 1 78 | 0 24 | 0.50 | | 9 36 | 0 62 | 0.34 | 62.39 |
| MD. 1 | 169 10 | 15 75 | | | 15.75 | 23.60 | 13 79 | 10 74 | 3.08 | 8 86 | 4 75 | 7.11 | 95.91 | | 7 42 | 5 16 | 2 50 | 26 30 | 2.15 | 81 56 | | 22.24 | 12 20 | 3 95 | 2.04 | 43 15 | | 19.62 | 2 65 | 5.51 | | 108 73 | 7 25 | 3 99 | 724 86 |
| MD. 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WI | 15 30 | 1.42 | | | 1.46 | 2.15 | 1 28 | 0 99 | 0 29 | 0 82 | 0 44 | 0 66 | 7.58 | | 0.74 | 0 48 | 0.23 | 2 43 | 0 20 | 7 48 | | 2 05 | 1 13 | 0 37 | 0.19 | 3 98 | | 1 81 | 0 25 | 0.51 | | 9.75 | 0 65 | 0 36 | 65 00 |
| AN | 10.45 | 0.97 | | | 1.02 | 1 50 | 0.90 | 0.70 | 0 20 | 0 58 | 0 31 | 0 47 | 5 26 | | 0 48 | 0 35 | 0 16 | 1 72 | 0 14 | 5 25 | | 1 45 | 0 80 | 0 26 | 0 13 | 2.81 | | 1 28 | 0 17 | 0.36 | | 6 79 | 0 45 | 0 25 | 45 21 |
| KDL | 5 01 | 0 47 | | | 0 50 | 0.73 | 0.44 | 0.35 | 0 10 | 0 29 | 0 15 | 0.23 | 2.56 | | 0 24 | 0 17 | 0.08 | 0 84 | 0.07 | 2 56 | | 0 71 | 0 39 | 0.13 | 0 07 | 1 38 | | 0 63 | 0 09 | 0 18 | | 3 30 | 0 22 | 0 12 | 22.01 |
| KX | 53.25 | 4.96 | | | 5.13 | 7.63 | 4 54 | 3 53 | 1 01 | 2 92 | 1.56 | 2 34 | 26.73 | | 2 43 | 1 70 | 0 83 | 9 03 | 0 71 | 26 77 | | 7 34 | 4 03 | 1 30 | 0.67 | 14 23 | | 6 47 | 0 87 | 1 82 | | 34 48 | 2.30 | 1.26 | 229.84 |
| HC | 4.31 | 0 40 | | | 0.43 | 0.63 | 0.38 | 0.30 | 0.09 | 0.24 | 0 13 | 0 20 | 2 20 | | 0 20 | 0 14 | 0.47 | 0 72 | 0 06 | 2 21 | | 0 61 | 0 34 | 0 11 | 0 06 | 1.19 | | 0 54 | 0 07 | 0 15 | | 2.84 | 0.19 | 0 10 | 18.91 |
| HK. 1 | 166.38 | 15.50 | | | 15 78 | 23.85 | 13.95 | 10 86 | 3 12 | 8 98 | 4 81 | 7.19 | 82.31 | | 7 46 | 5 23 | 2 54 | 26 64 | 2.18 | 97 72 | | 22 61 | 12 38 | 4 01 | 2.07 | 43 99 | | 19.92 | 2.69 | 5.60 | | 109 25 | 7 28 | 4 01 | 728 31 |
| HK. 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ND | 44.83 | 4.17 | | | 4.34 | 6.47 | 3 85 | 3 00 | 0.86 | 2 48 | 1 33 | 1.99 | 22.56 | | 2 06 | 1 44 | 0.70 | 7 37 | 0 60 | 22 89 | | 6 51 | 3 43 | 1 11 | 0 57 | 12.18 | | 5 51 | 0 74 | 1 55 | | 29 21 | 1 95 | 1 07 | 194 77 |
| MHG | 24.44 | 2.28 | | | 2.40 | 3.56 | 2.14 | 1.67 | 0.48 | 1.38 | 0.74 | 1.11 | 12 43 | | 1 14 | 0.80 | 0 39 | 4 09 | 0 34 | 12 53 | | 3 47 | 1.99 | 0 62 | 0 32 | 6 75 | | 3 07 | 0 42 | 0.86 | | 16.07 | 1.07 | 0.59 | 107.15 |
| HO | 7.87 | 0.73 | | | 0.78 | 1.16 | 0 70 | 0 55 | 0.16 | 0 45 | 0 24 | 0 36 | 4.04 | | 0 37 | 0 26 | 0.13 | 1 34 | 0 11 | 4 06 | | 1 13 | 0 62 | 0 21 | 0 11 | 2 20 | | 1 00 | 0 14 | 0 28 | | 5 21 | 0 35 | 0 19 | 34 75 |
| PK | 4.04 | 0 38 | | | 0.41 | 0 60 | 0 37 | 0 29 | 0 08 | 0.24 | 0 13 | 0.19 | 2 10 | | 0 19 | 0 14 | 0 07 | 0 70 | 0 06 | 2 11 | | 0 59 | 0 33 | 0 11 | 0.06 | 1 15 | | 0 53 | 0.07 | 0.15 | | 2 71 | 0 18 | 0 10 | 18.08 |
| MV. 1 | 87.32 | 8.13 | | | 8.49 | 12.67 | 7 56 | 5.89 | 1.69 | 4 87 | 2 61 | 3 90 | 44 03 | | 4 03 | 2 84 | 1.38 | 14 44 | 1 19 | 44 71 | | 12 28 | 6 73 | 2 18 | 1 13 | 26 03 | | 10.85 | 1 47 | 3 05 | | 57 42 | 3 83 | 2 11 | 382 83 |
| MV. 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MF | 39.07 | 3.64 | | | 3 87 | 5.75 | 3.47 | 2.70 | 0.78 | 2 24 | 1.20 | 1 79 | 20.00 | | 1.84 | 1.30 | 0 63 | 6 61 | 0 54 | 20 19 | | 5.61 | 3 09 | 1.00 | 0 52 | 10 94 | | 5 21 | 0 67 | 1.40 | | 25 90 | 1 73 | 0 95 | 172.64 |
| PYL | 5.29 | 0.49 | | | 0.52 | 0.78 | 0 47 | 0.36 | 0 10 | 0 30 | 0 16 | 0.24 | 2.71 | | 0 25 | 0 18 | 0 09 | 0 89 | 0.07 | 2 73 | | 0 76 | 0 42 | 0 14 | 0.07 | 1 48 | | 0.67 | 0 10 | 0.19 | | 3 50 | 0 23 | 0 13 | 23 32 |
| BS | 11.05 | 1 03 | | | 1.08 | 1.61 | 0.96 | 0 75 | 0 22 | 0.62 | 0.33 | 0 50 | 5.61 | | 0 51 | 0 36 | 0 18 | 1 84 | 0.15 | 5 67 | | 1 57 | 0.86 | 0 28 | 0 14 | 3 05 | | 1 38 | 0.19 | 0 41 | | 7.25 | 0.48 | 0 27 | 48 35 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| STD | 243.82 | 22.71 | | | 21.12 | 31.20 | 18.10 | 14.12 | 3 50 | 11.70 | 6 27 | 9.36 | 108.73 | | 9.75 | 6 79 | 3 30 | 34.48 | 2 84 | 109 25 | | 29 21 | 16 07 | 5 21 | 2.71 | 57.42 | | 25 90 | 3.50 | 7 25 | | | | | 804 31 |
| ISD | 81.27 | 7.57 | | | 1.41 | 2.08 | 1.21 | 0.94 | 0.23 | 0 78 | 0 42 | 0 62 | 7.25 | | 0 65 | 0 45 | 0.22 | 2 30 | 0 19 | 7 28 | | 1 95 | 1.07 | 0 35 | 0.18 | 3 83 | | 1 73 | 0 23 | 0.48 | | | | | 124.69 |
| SPL | 8.94 | 0.83 | | | 0.77 | 1 14 | 0.66 | 0 52 | 0 13 | 0.43 | 0.23 | 0.34 | 3.99 | | 0.36 | 0 25 | 0 12 | 1 26 | 0 10 | 4.01 | | 1 07 | 0 59 | 0 19 | 0 10 | 2 11 | | 0 95 | 0 13 | 0 27 | | | | | 29.49 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL | 1,684.79 | 156.91 | | | 135.96 | 202.50 | 118.71 | 92.49 | 25.93 | 76.44 | 40 92 | 61.22 | 714 93 | | 63 57 | 44 43 | 21 58 | 226 41 | 18.55 | 716.48 | | 191 74 | 105.21 | 34 09 | 17.65 | 374.77 | | 169 42 | 22 87 | 47.52 | | 804.31 | 124 69 | 29 49 | 6,323.58 |

Table 5-5 (2/4) Traffic Flow as of 1992

| FROM \ TO | CO.1 | CO.2 | CO.3 | CO.4 | MTK | KPT | KI | WT | RG | JL | MAL | KDW | MD.1 | MD.2 | WI | AN | KDL | KX | HC | HK.1 | HK.2 | ND | MHG | HO | PK | MV.1 | MV.2 | MF | PYL | BS | | STD | ISD | SPL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO.1 | 490.96 | 181 63 | | | 42 60 | 50 22 | 30.58 | 24 32 | 6.88 | 24 55 | 13 34 | 17.68 | 164 69 | | 18 59 | 11.99 | 6 68 | 53 29 | 5 97 | 176 72 | | 67 14 | 27 83 | 11.46 | 6 71 | 85 58 | 12 55 | 40 22 | 7 26 | 9.52 | | 299 99 | 100.00 | 11 00 | 1.999.94 |
| CO.2 | 181.63 | 67.19 | | | 15 76 | 18 58 | 11 31 | 9 00 | 2 54 | 9 08 | 4.93 | 6 54 | 60.92 | | 6.88 | 4 44 | 2 47 | 19 71 | 2.21 | 65.38 | | 24 84 | 10 30 | 4 24 | 2 48 | 31 66 | 4 64 | 14 88 | 2 68 | 3 52 | | 110 98 | 36 99 | 4 07 | 739 86 |
| CO.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CO.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MTK | 47.65 | 17.63 | | | 7 33 | 7.24 | 4 48 | 3 57 | 1.01 | 3 59 | 1 95 | 2 59 | 23.87 | | 2 72 | 1 75 | 0 96 | 7 78 | 0 87 | 25 62 | | 9 80 | 4 07 | 1.67 | 0.98 | 12.48 | 1 83 | 5 87 | 1 06 | 1.39 | | 35 91 | 2 39 | 1.32 | 239.40 |
| KPT | 56 03 | 20.73 | | | 7 16 | 9.99 | 5 18 | 4.12 | 1 17 | 4 16 | 2.26 | 3 00 | 28 11 | | 3 15 | 2 04 | 1 13 | 9 06 | 1 01 | 30 43 | | 11 42 | 4 73 | 1 95 | 1 14 | 14 57 | 2 14 | 6 83 | 1 23 | 1.62 | | 42 13 | 2.81 | 1.54 | 280 84 |
| KI | 33.27 | 12.31 | | | 4.46 | 5.15 | 3.33 | 2.55 | 0.72 | 2 57 | 1.39 | 1 85 | 17 02 | | 1.95 | 1 26 | 0 70 | 5 57 | 0 62 | 18 28 | | 7 01 | 2 91 | 1 20 | 0 70 | 8 92 | 1 31 | 4 20 | 0 76 | 0.99 | | 25 34 | 1.69 | 0.93 | 168 96 |
| WT | 26 30 | 9.73 | | | 3.56 | 4 11 | 2.57 | 2.13 | 0.58 | 2.07 | 1.12 | 1 49 | 13 55 | | 1 56 | 1.01 | 0 56 | 4 47 | 0 50 | 14 60 | | 5 62 | 2 33 | 0 96 | 0.56 | 7 15 | 1.05 | 3 37 | 0 61 | 0.80 | | 20.20 | 1 35 | 0 74 | 134 64 |
| RG | 7 36 | 2.72 | | | 1.01 | 1.17 | 0.73 | 0 59 | 0.17 | 0.59 | 0.32 | 0 43 | 3 85 | | 0 44 | 0 29 | 0 16 | 1 28 | 0 14 | 4 16 | | 1 61 | 0 67 | 0 28 | 0 16 | 2 05 | 0 30 | 0 97 | 0 17 | 0 23 | | 5.72 | 0 38 | 0 21 | 38.16 |
| JL | 26.14 | 9 67 | | | 3 59 | 4 18 | 2.63 | 2 10 | 0.60 | 2 23 | 1 15 | 1.53 | 13 75 | | 1 59 | 1 03 | 0.58 | 4 59 | 0 51 | 14 87 | | 5 78 | 2 40 | 0.99 | 0 58 | 7.34 | 1.08 | 3 47 | 0 63 | 0.82 | | 20.46 | 1 36 | 0 75 | 136.40 |
| MAL | 14.11 | 5 22 | | | 1.95 | 2.28 | 1.44 | 1 14 | 0 32 | 1.16 | 0.66 | 0 84 | 7 49 | | 0 87 | 0.57 | 0.32 | 2 51 | 0 28 | 8 13 | | 3 16 | 1 31 | 0.54 | 0 32 | 4.01 | 0 59 | 1 89 | 0.34 | 0.45 | | 11 12 | 0 74 | 0 41 | 74.16 |
| KDW | 18.87 | 6.98 | | | 2.58 | 3 01 | 1.89 | 1 51 | 0.43 | 1.52 | 0 83 | 1.15 | 9 94 | | 1 14 | 0.74 | 0 41 | 3 29 | 0 37 | 10 69 | | 4 14 | 1 72 | 0.71 | 0 42 | 5.26 | 0 77 | 2.48 | 0 45 | 0.59 | | 14 72 | 0 98 | 0 54 | 98.12 |
| MD.1 | 181.31 | 67 08 | | | 23 34 | 27.76 | 16.83 | 13.38 | 3 78 | 13.51 | 7 34 | 9 74 | 106 27 | | 10.29 | 6.61 | 3.68 | 29 39 | 3 29 | 97 68 | | 37.00 | 15.33 | 6.31 | 3.69 | 47.16 | 6 92 | 22.14 | 4 00 | 5.24 | | 138 24 | 9 22 | 5.07 | 921.60 |
| MD.2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WI | 20.46 | 7 57 | | | 2 70 | 3.15 | 1.95 | 1 55 | 0 44 | 1.56 | 0.85 | 1.12 | 10 48 | | 1.28 | 0 76 | 0 42 | 3 39 | 0 38 | 11 18 | | 4 26 | 1 77 | 0 73 | 0.43 | 5 43 | 0 80 | 2 55 | 0 46 | 0 60 | | 15.51 | 1 03 | 0.57 | 103 40 |
| AN | 12.90 | 4.77 | | | 1.74 | 2 03 | 1.27 | 1 01 | 0 29 | 1.02 | 0.55 | 0 73 | 6 72 | | 0 77 | 0 52 | 0 38 | 2 22 | 0.25 | 7.25 | | 2 78 | 1 16 | 0 48 | 0.28 | 3 54 | 0 52 | 1 67 | 0 30 | 0 39 | | 9 97 | 0 66 | 0 37 | 66 44 |
| KDL | 7.11 | 2 63 | | | 0 97 | 1 14 | 0 71 | 0 57 | 0 16 | 0 57 | 0 31 | 0 42 | 3 75 | | 0.43 | 0 28 | 0 16 | 1 25 | 0 14 | 4 06 | | 1 57 | 0 63 | 0 27 | 0 16 | 2 00 | 0 29 | 0 94 | 0 17 | 0 22 | | 5 56 | 0 37 | 0 20 | 37 08 |
| KX | 57.47 | 21.26 | | | 7.65 | 9.03 | 5 57 | 4 43 | 1 25 | 4 47 | 2 44 | 3 23 | 29.81 | | 3.39 | 2 20 | 1 22 | 10 16 | 1.09 | 32.27 | | 12 29 | 5 09 | 2 09 | 1 23 | 15 65 | 2 30 | 7 34 | 1 33 | 1 74 | | 44 22 | 2 95 | 1 62 | 294 80 |
| HC | 6.35 | 2 35 | | | 0 87 | 1 02 | 0 64 | 0 51 | 0 14 | 0.51 | 0 28 | 0.37 | 3.35 | | 0.38 | 0 25 | 0 14 | 1 11 | 0 13 | 3 63 | | 1 40 | 0 58 | 0 24 | 0 14 | 1 78 | 0 26 | 0 84 | 0 15 | 0 20 | | 4 97 | 0 33 | 0 18 | 33 12 |
| HK.1 | 192.62 | 71.26 | | | 25 25 | 30.30 | 18.38 | 14.62 | 4 14 | 14.77 | 8 04 | 10 64 | 98 47 | | 11 16 | 7 23 | 4 02 | 32 16 | 3 60 | 126 37 | | 40 61 | 16 80 | 6 91 | 4 04 | 51 91 | 7 61 | 24 27 | 4 38 | 5 75 | | 150 14 | 10 01 | 5 51 | 1.000 96 |
| HK.2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ND | 71 96 | 26 62 | | | 9 62 | 11.41 | 7.03 | 5.60 | 1.58 | 5.65 | 3 08 | 4 07 | 37.42 | | 4.27 | 2 77 | 1 54 | 12.33 | 1 38 | 41.04 | | 16 21 | 6 45 | 2 65 | 1 55 | 19 93 | 2 92 | 9 30 | 1 68 | 2 21 | | 55 77 | 3 72 | 2 04 | 371.80 |
| MHG | 29.64 | 10.97 | | | 4.02 | 4 74 | 2.95 | 2 35 | 0 67 | 2 38 | 1 30 | 1 71 | 15 58 | | 1.79 | 1 16 | 0 65 | 5 17 | 0 58 | 16 98 | | 6 53 | 2 83 | 1 12 | 0 65 | 8 34 | 1 22 | 3 91 | 0 71 | 0.93 | | 23.17 | 1 54 | 0 85 | 154.44 |
| HO | 12.13 | 4.49 | | | 1.67 | 1 96 | 1 23 | 0 98 | 0.28 | 0.99 | 0 54 | 0 71 | 6.44 | | 0 74 | 0 48 | 0 27 | 2 15 | 0 24 | 7 00 | | 2 71 | 1 13 | 0 49 | 0 27 | 3 45 | 0 51 | 1 63 | 0.29 | 0.39 | | 9 56 | 0 64 | 0 35 | 63 72 |
| PK | 7.06 | 2 61 | | | 0 98 | 1 15 | 0 73 | 0 58 | 0.16 | 0.59 | 0 32 | 0.42 | 3.79 | | 0 44 | 0 29 | 0 16 | 1 27 | 0 14 | 4 11 | | 1 61 | 0 67 | 0 28 | 0 17 | 2 04 | 0 30 | 0 97 | 0 17 | 0.23 | | 5 62 | 0 37 | 0 21 | 37.44 |
| MV.1 | 92.13 | 34 08 | | | 12.37 | 14.67 | 9.08 | 7 23 | 2 05 | 7.30 | 3 97 | 5 26 | 48.00 | | 5 50 | 3 57 | 1 99 | 15 88 | 1 78 | 52.69 | | 20 10 | 8 33 | 3 42 | 2 00 | 27 99 | 4 11 | 12 04 | 2 17 | 2 85 | | 72 00 | 4 80 | 2 64 | 480 00 |
| MV.2 | 13 51 | 5.00 | | | 1.81 | 2 15 | 1.33 | 1 06 | 0.30 | 1.07 | 0 58 | 0 77 | 7.04 | | 0 81 | 0 52 | 0 29 | 2 33 | 0 26 | 7 73 | | 2 95 | 1 22 | 0 50 | 0 29 | 4 11 | 0 60 | 1 77 | 0 32 | 0 42 | | 10 56 | 0 70 | 0 39 | 70 40 |
| MF | 42.57 | 15 75 | | | 5.82 | 6 87 | 4.30 | 3 42 | 0 97 | 3.46 | 1.88 | 2 49 | 22.52 | | 2 59 | 1 69 | 0 34 | 7 51 | 0 84 | 24 57 | | 9 49 | 3 94 | 1 62 | 0 95 | 12 15 | 1 78 | 5 98 | 1 03 | 1.35 | | 33 53 | 2 24 | 1 23 | 223 52 |
| PYL | 7 70 | 2.85 | | | 1.05 | 1 24 | 0.78 | 0 62 | 0 17 | 0.62 | 0 34 | 0 45 | 4.07 | | 0 47 | 0 31 | 0 17 | 1.36 | 0 15 | 4 44 | | 1 71 | 0 71 | 0 29 | 0 17 | 2 19 | 0 32 | 1 03 | 0 19 | 0.24 | | 6 05 | 0 40 | 0 22 | 40.32 |
| BS | 10.15 | 3.75 | | | 1.37 | 1.62 | 1.01 | 0 80 | 0.23 | 0.81 | 0 44 | 0 58 | 5.32 | | 0 61 | 0 40 | 0 22 | 1 77 | 0 20 | 5 82 | | 2.23 | 0.93 | 0 38 | 0 22 | 2 86 | 0 42 | 1 34 | 0 24 | 0.33 | | 7.92 | 0.53 | 0.29 | 52 80 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| STD | 299.99 | 110.98 | | | 35.91 | 42.13 | 25.34 | 20.20 | 5.72 | 20.46 | 11.12 | 14.72 | 138 24 | | 15.51 | 9 97 | 5 56 | 44 22 | 4 97 | 150 14 | | 55 77 | 23.17 | 9 56 | 5 62 | 72 00 | 10 56 | 33 53 | 6 05 | 7 92 | | | | | 1.179 36 |
| ISD | 100.00 | 36.99 | | | 2.39 | 2.81 | 1.69 | 1 35 | 0.38 | 1.36 | 0 74 | 0 98 | 9.22 | | 1.03 | 0 66 | 0 37 | 2 95 | 0 33 | 10.01 | | 3 72 | 1 54 | 0 64 | 0 37 | 4 80 | 0 70 | 2 24 | 0 40 | 0 53 | | | | | 188 20 |
| SPL | 11.00 | 4.07 | | | 1.32 | 1.54 | 0.93 | 0 74 | 0.21 | 0.75 | 0 41 | 0.54 | 5.07 | | 0.57 | 0.37 | 0 20 | 1.62 | 0 18 | 5 51 | | 2.04 | 0 85 | 0 35 | 0 21 | 2 64 | 0 39 | 1 23 | 0 22 | 0 29 | | | | | 43.25 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL | 2,078.38 | 768.89 | | | 230.85 | 272.65 | 165.89 | 132.03 | 37.34 | 133.37 | 72.48 | 96.05 | 904.75 | | 100.92 | 65 16 | 36 27 | 289.79 | 32 41 | 981 36 | | 365 50 | 151 42 | 62.33 | 36 49 | 468 99 | 68 79 | 218 90 | 39 45 | 51 76 | | 1.179 36 | 188 20 | 43 25 | 9.273 03 |

Table 5-5 (3/4) Traffic Flow as of 1997

| FROM \ TO | CO. 1 | CO. 2 | CO. 3 | CO. 4 | MTK | KPT | KI | WT | RG | JL | MAL | KDW | MD. 1 | MD. 2 | WI | AN | KDL | KX | HC | HK. 1 | HK 2 | ND | MHG | HO | PK | MV. 1 | MV. 2 | MF | PYL | BS | | STD | ISD | SPL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO. 1 | 351.43 | 210.23 | 103 54 | | 47 79 | 54 83 | 29.38 | 22.81 | 6 57 | 24 21 | 14 41 | 20.06 | 158.17 | | 19 05 | 14 75 | 6 78 | 49 00 | 6 24 | 135 48 | 56 76 | 78 30 | 25 31 | 10.17 | 6 04 | 55 13 | 30 69 | 38 67 | 5 94 | 7.20 | | 299 99 | 100 00 | 11.00 | 1,999.93 |
| CO. 2 | 210.23 | 125.76 | 61.94 | | 28.59 | 32 80 | 17 57 | 13.65 | 3 93 | 14.48 | 8 62 | 12 00 | 94 62 | | 11.39 | 8 82 | 4 06 | 29.31 | 3 74 | 81.04 | 33 96 | 46 84 | 15.14 | 6 08 | 3 61 | 32 98 | 18 36 | 23 13 | 3 56 | 4 31 | | 179 46 | 59.82 | 6 58 | 1,196 38 |
| CO. 3 | 103.54 | 61.94 | 30 51 | | 14 08 | 16 16 | 8.66 | 6.72 | 1 94 | 7.13 | 4.25 | 5.91 | 46 60 | | 5 61 | 4 34 | 2 00 | 14 44 | 1 84 | 39 92 | 16 72 | 23 07 | 7.46 | 3 00 | 1 78 | 16 24 | 9 04 | 11 39 | 1 75 | 2 12 | | 88 38 | 29.46 | 3.24 | 589 24 |
| CO. 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MTK | 53 32 | 31.90 | 15 71 | | 12 86 | 12 35 | 6 73 | 5.23 | 1 50 | 5 54 | 3.30 | 4.59 | 35 84 | | 4 36 | 3.37 | 1 55 | 11 19 | 1 43 | 30 70 | 12 86 | 17 88 | 5.78 | 2 32 | 1 38 | 12 57 | 7.00 | 8 83 | 1 36 | 1 64 | | 56 28 | 3 75 | 2 06 | 375 18 |
| KPT | 61.03 | 36 51 | 17.98 | | 12.23 | 16.60 | 7.58 | 5 89 | 1.70 | 6 25 | 3 72 | 5.18 | 41 08 | | 4 92 | 3 81 | 1 75 | 12 67 | 1 61 | 35 49 | 14 87 | 20 26 | 6 54 | 2 63 | 1 56 | 14 28 | 7 95 | 10 00 | 1.54 | 1 86 | | 64 26 | 4 28 | 2 36 | 428.39 |
| KI | 31.91 | 19.09 | 9.40 | | 6 70 | 7 54 | 4.29 | 3.21 | 0.92 | 3.39 | 2 02 | 2 81 | 21 90 | | 2 68 | 2 07 | 0 95 | 6 86 | 0 87 | 18 78 | 7.87 | 10 95 | 3.54 | 1 42 | 0 83 | 7 70 | 4.28 | 5 41 | 0 83 | 1 01 | | 34.02 | 2 27 | 1.25 | 226 79 |
| WT | 24.62 | 14.73 | 7 25 | | 5.22 | 5.87 | 3.23 | 2 62 | 0.72 | 2 66 | 1.58 | 2 21 | 17.02 | | 2 09 | 1 62 | 0 75 | 5 37 | 0.69 | 14 64 | 6 13 | 8 58 | 2 77 | 1 12 | 0 66 | 6 02 | 3.35 | 4 24 | 0.65 | 0 79 | | 26 46 | 1 76 | 0.97 | 176 39 |
| RG | 7.02 | 4.20 | 2.07 | | 1 50 | 1.70 | 0.94 | 0.73 | 0.22 | 0 78 | 0.46 | 0 65 | 4 93 | | 0 61 | 0 47 | 0 22 | 1 57 | 0 20 | 4.25 | 1 76 | 2 50 | 0 81 | 0 33 | 0 19 | 1 76 | 0.98 | 1 24 | 0 19 | 0.23 | | 7 64 | 0 51 | 0 28 | 50.96 |
| JL | 25.73 | 15.39 | 7 58 | | 5.54 | 6.28 | 3.48 | 2 71 | 0.78 | 3 02 | 1.71 | 2 39 | 18 16 | | 2 24 | 1 75 | 0 81 | 5.80 | 0 74 | 15 68 | 6 57 | 9 27 | 3 00 | 1 21 | 0 72 | 6 50 | 3 62 | 4 59 | 0 71 | 0 85 | | 28.19 | 1.88 | 1.03 | 187.93 |
| MAL | 15.22 | 9 11 | 4.48 | | 3 29 | 3.75 | 2.08 | 1.62 | 0.47 | 1.72 | 1.08 | 1.43 | 10 85 | | 1 34 | 1 05 | 0 48 | 3 47 | 0 45 | 9 40 | 3 94 | 5.55 | 1 80 | 0 72 | 0 43 | 3 89 | 2.17 | 2 75 | 0 42 | 0.51 | | 16.80 | 1 12 | 0 62 | 112.01 |
| KDW | 21 37 | 12.78 | 6.30 | | 4.58 | 5.19 | 2.87 | 2 23 | 0 65 | 2 37 | 1.42 | 2 06 | 15 10 | | 1 85 | 1 44 | 0 67 | 4 78 | 0 61 | 12 97 | 5 43 | 7 64 | 2 47 | 1 00 | 0 59 | 5 36 | 2 98 | 3.78 | 0 58 | 0 70 | | 23 33 | 1 56 | 0 86 | 155 52 |
| MD. 1 | 173.97 | 104 07 | 51.26 | | 35 10 | 40.64 | 21 68 | 16.83 | 4 85 | 17.85 | 10 64 | 14 81 | 136 82 | | 14 12 | 10 89 | 5 01 | 36 23 | 4 61 | 100 38 | 42.06 | 57.84 | 18 69 | 7 50 | 4 46 | 40 72 | 22 67 | 28 53 | 4.39 | 5 32 | | 185.49 | 12 37 | 6 80 | 1,236 60 |
| MD. 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WI | 20.92 | 12 52 | 6.16 | | 4 33 | 4.92 | 2 67 | 2.07 | 0.60 | 2.20 | 1 31 | 1 82 | 14 37 | | 1.88 | 1 34 | 0 62 | 4.45 | 0 57 | 12 25 | 5 13 | 7 10 | 2 30 | 0 92 | 0 55 | 5 00 | 2 78 | 3 51 | 0 54 | 0 65 | | 22 19 | 1.48 | 0.81 | 147 96 |
| AN | 15.83 | 9.47 | 4.67 | | 3 34 | 3 81 | 2.09 | 1.62 | 0 47 | 1 72 | 1.03 | 1 43 | 11 06 | | 1 35 | 1.10 | 0 48 | 3 49 | 0 45 | 9 53 | 3 99 | 5 57 | 1.80 | 0 72 | 0 43 | 3 91 | 2 18 | 2 75 | 0 42 | 0 51 | | 17.12 | 1 14 | 0 63 | 114.11 |
| KDL | 7.21 | 4.31 | 2.12 | | 1.54 | 1.76 | 0 97 | 0.76 | 0 22 | 0 80 | 0 48 | 0 67 | 5 10 | | 0.63 | 0 49 | 0 24 | 1 62 | 0 21 | 4 41 | 1 85 | 2 59 | 0 84 | 0 34 | 0 20 | 1 82 | 1 01 | 1 28 | 0 20 | 0 24 | | 7 90 | 0 53 | 0 29 | 52 63 |
| KX | 52.75 | 31.56 | 15.54 | | 11.00 | 12.65 | 6.87 | 5 33 | 1 54 | 5 66 | 3 38 | 4 69 | 36 72 | | 4 46 | 3 46 | 1 59 | 11 98 | 1 47 | 31 72 | 13 29 | 18 38 | 5 94 | 2.38 | 1 42 | 12 93 | 7 20 | 9 05 | 1 39 | 1 69 | | 56 81 | 3 79 | 2 08 | 378 72 |
| HC | 6.64 | 3.97 | 1.96 | | 1.42 | 1.62 | 0 89 | 0.69 | 0 20 | 0.74 | 0 44 | 0 61 | 4 69 | | 0 58 | 0 45 | 0 21 | 1.49 | 0 20 | 4 06 | 1 70 | 2 39 | 0 77 | 0 31 | 0 18 | 1.68 | 0.93 | 1.18 | 0.18 | 0 22 | | 7 27 | 0 48 | 0.27 | 48 42 |
| HK. 1 | 147.09 | 87.99 | 43 34 | | 30.22 | 35.29 | 18.84 | 14 63 | 4.22 | 15.54 | 9 27 | 12.88 | 100 90 | | 12.20 | 9 48 | 4 36 | 31 55 | 4 02 | 103 35 | 43 30 | 50.53 | 16 30 | 6 54 | 3 89 | 35 67 | 19 86 | 24 89 | 3 83 | 4 64 | | 160.80 | 10.72 | 5 90 | 1,072 04 |
| HK. 2 | 61.63 | 36.87 | 18.16 | | 12.66 | 14 79 | 7.89 | 6.13 | 1 77 | 6 51 | 3.88 | 5 40 | 42 27 | | 5 11 | 3 97 | 1 83 | 13 22 | 1 68 | 43 30 | 18 14 | 21 17 | 6 83 | 2 74 | 1.63 | 14 95 | 8 32 | 10 43 | 1 60 | 1 94 | | 67 37 | 4.49 | 2 47 | 449 15 |
| ND | 83.73 | 50.09 | 24.67 | | 17.54 | 20 24 | 10.99 | 8 53 | 2.46 | 9.06 | 5 41 | 7.51 | 58 42 | | 7.11 | 5 53 | 2 55 | 18 43 | 2 35 | 51 14 | 21 43 | 30 72 | 9.54 | 3 82 | 2 27 | 20 87 | 11 62 | 14 54 | 2 24 | 2 72 | | 90.86 | 6 06 | 3 33 | 605 78 |
| MHG | 26.91 | 16.10 | 7.93 | | 5.72 | 6.57 | 3.60 | 2.80 | 0 81 | 2 97 | 1.78 | 2 46 | 18 97 | | 2 32 | 1.81 | 0 84 | 6 03 | 0 77 | 16 50 | 6 91 | 9 66 | 3 27 | 1 26 | 0 75 | 6 81 | 3.79 | 4 77 | 0 74 | 0.89 | | 29 43 | 1 96 | 1.08 | 196 21 |
| HO | 10.74 | 6.43 | 3.16 | | 2.31 | 2.65 | 1.46 | 1 14 | 0.33 | 1.21 | 0 72 | 1.00 | 7 65 | | 0.94 | 0 74 | 0 34 | 2 45 | 0 31 | 6 64 | 2 78 | 3.91 | 1.27 | 0 53 | 0 30 | 2 75 | 1 53 | 1 94 | 0 30 | 0 36 | | 11 84 | 0 79 | 0.43 | 78 95 |
| PK | 6.33 | 3.79 | 1.87 | | 1.38 | 1.58 | 0 88 | 0 68 | 0 20 | 0.73 | 0.44 | 0 60 | 4 56 | | 0 56 | 0 44 | 0 20 | 1.47 | 0 19 | 3 96 | 1 66 | 2 35 | 0 76 | 0 31 | 0 19 | 1 65 | 0 92 | 1.16 | 0 18 | 0 22 | | 7 06 | 0.47 | 0 26 | 47.05 |
| MV. 1 | 59.29 | 35.47 | 17.47 | | 12 48 | 14 40 | 7.84 | 6.09 | 1.76 | 6 47 | 3 86 | 5.36 | 41.45 | | 5.06 | 3 95 | 1.82 | 13 13 | 1 68 | 36 31 | 15 21 | 21 07 | 6.81 | 2 73 | 1 62 | 16 21 | 9 02 | 10 41 | 1 60 | 1.94 | | 64 80 | 4 32 | 2 38 | 432 01 |
| MV. 2 | 33.01 | 19 74 | 9.72 | | 6.95 | 8.02 | 4.36 | 3 39 | 0 98 | 3.60 | 2 15 | 2 99 | 23 07 | | 2.82 | 2 20 | 1 01 | 7 31 | 0 93 | 20 22 | 8 47 | 11 73 | 3.79 | 1 52 | 0 90 | 9 02 | 5 02 | 5 80 | 0 89 | 1 08 | | 36 07 | 2 40 | 1 32 | 240.48 |
| MF | 40.86 | 24.44 | 12.04 | | 8.76 | 10.06 | 5.54 | 4.30 | 1.24 | 4 58 | 2 73 | 3.79 | 29.00 | | 3.56 | 2 79 | 1 29 | 9 26 | 1 18 | 25 26 | 10 58 | 14 84 | 4 81 | 1 93 | 1 15 | 10 50 | 5 84 | 7 70 | 1 13 | 1.37 | | 45 04 | 3 00 | 1 65 | 300 22 |
| PYL | 6.29 | 3.77 | 1.85 | | 1.35 | 1.55 | 0.85 | 0.66 | 0 19 | 0 70 | 0.42 | 0 58 | 4.46 | | 0 55 | 0 43 | 0 20 | 1.42 | 0 18 | 3 89 | 1 63 | 2 28 | 0 74 | 0 30 | 0 18 | 1 61 | 0 90 | 1 13 | 0 18 | 0.21 | | 6 93 | 0 46 | 0 25 | 46 14 |
| BS | 7.66 | 4.58 | 2.26 | | 1 62 | 1.87 | 1.02 | 0 79 | 0.23 | 0.84 | 0 50 | 0.70 | 5 39 | | 0 66 | 0 51 | 0.24 | 1 71 | 0 22 | 4 70 | 1 97 | 2 75 | 0.89 | 0 36 | 0 21 | 1 94 | 1 08 | 1 36 | 0 21 | 0.26 | | 8 37 | 0.56 | 0 31 | 55 77 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| STD | 299.99 | 179.46 | 88 38 | | 56.28 | 64.26 | 34.02 | 26.46 | 7.64 | 28.19 | 16 80 | 23 33 | 185 49 | | 22.19 | 17 12 | 7.00 | 56 81 | 7.27 | 160 80 | 67 37 | 90 86 | 29 43 | 11.84 | 7 06 | 64 80 | 36 07 | 45.04 | 6.93 | 8.37 | | | | | 1,650.16 |
| ISD | 100.00 | 59.82 | 29.46 | | 3.75 | 4 28 | 2.27 | 1 76 | 0 51 | 1.88 | 1.12 | 1 56 | 12 37 | | 1.48 | 1.14 | 0 53 | 3.79 | 0 48 | 10 72 | 4.49 | 6 06 | 1.96 | 0 79 | 0 47 | 4 32 | 2 40 | 3 00 | 0 46 | 0 56 | | | | | 261.43 |
| SPL | 11.00 | 6.58 | 3.24 | | 2.06 | 2.36 | 1 25 | 0.97 | 0.28 | 1.03 | 0.62 | 0.86 | 6.80 | | 0.81 | 0 63 | 0 29 | 2.08 | 0.27 | 5 90 | 2 47 | 3.33 | 1 08 | 0 43 | 0 26 | 2 38 | 1 32 | 1 65 | 0.25 | 0 31 | | | | | 60 51 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL | 2,077.27 | 1,242.67 | 612.02 | | 362.19 | 416.39 | 222.79 | 173.05 | 49.90 | 183.83 | 109 55 | 159 34 | 1,213 83 | | 144.53 | 111.96 | 51 57 | 372.38 | 47.46 | 1,053 39 | 441 32 | 595.97 | 192 44 | 77 27 | 45 93 | 421 97 | 234.88 | 294 15 | 45 19 | 54 72 | | 1,650.16 | 261.43 | 60 51 | 12 973 06 |

Table 5-5 (4/4) Traffic Flow as of 2002

| FROM \ TO | CO. 1 | CO. 2 | CO. 3 | CO. 4 | MTK | KPT | KI | WT | RG | JL | MAL | KDW | MD. 1 | MD. 2 | WI | AN | KDL | KX | HC | HK. 1 | HK. 2 | ND | MHG | HO | PK | MV. 1 | MV. 2 | MF | PYL | BS | | STD | ISD | SPL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO. 1 | 244.68 | 118.32 | 244.68 | 31.10 | 42.05 | 49.78 | 33.08 | 26.87 | 8.65 | 31.62 | 19.80 | 25.86 | 68.16 | 76.02 | 23.65 | 18.46 | 9.15 | 51.44 | 8.32 | 60.68 | 139.39 | 66.14 | 29.00 | 13.85 | 8.77 | 38.39 | 45.46 | 41.29 | 7.69 | 6.60 | | 299.99 | 100.00 | 11.00 | 1,999.94 |
| CO. 2 | 118.32 | 57.21 | 118.32 | 15.04 | 20.33 | 24.07 | 16.00 | 12.99 | 4.18 | 15.29 | 9.57 | 12.51 | 32.96 | 36.76 | 11.44 | 8.93 | 4.42 | 24.87 | 4.02 | 29.34 | 67.40 | 31.98 | 14.02 | 6.70 | 4.24 | 18.56 | 21.98 | 19.97 | 3.72 | 3.19 | | 145.07 | 48.36 | 5.32 | 967.08 |
| CO. 3 | 244.68 | 118.32 | 244.68 | 31.10 | 42.05 | 49.78 | 33.08 | 26.87 | 8.65 | 31.62 | 19.80 | 25.86 | 68.16 | 76.02 | 23.65 | 18.46 | 9.15 | 51.44 | 8.32 | 60.68 | 139.39 | 66.14 | 29.00 | 13.85 | 8.77 | 38.39 | 45.46 | 41.29 | 7.69 | 6.60 | | 299.99 | 100.00 | 11.00 | 1,999.94 |
| CO. 4 | 31.10 | 15.04 | 31.10 | 3.95 | 5.35 | 6.33 | 4.21 | 3.42 | 1.10 | 4.02 | 2.52 | 3.29 | 8.66 | 9.66 | 3.01 | 2.35 | 1.16 | 6.54 | 1.06 | 7.71 | 17.72 | 8.41 | 3.69 | 1.76 | 1.11 | 4.88 | 5.78 | 5.25 | 0.98 | 0.84 | | 38.13 | 12.71 | 1.40 | 254.24 |
| MTK | 46.65 | 22.56 | 46.65 | 5.93 | 14.22 | 14.09 | 9.53 | 7.74 | 2.49 | 9.09 | 5.69 | 7.44 | 19.41 | 21.65 | 6.80 | 5.30 | 2.63 | 14.76 | 2.39 | 17.28 | 39.70 | 18.97 | 8.32 | 3.98 | 2.52 | 11.00 | 13.02 | 11.85 | 2.21 | 1.89 | | 71.14 | 4.74 | 2.61 | 474.25 |
| KPT | 55.29 | 26.74 | 55.29 | 7.03 | 14.00 | 19.61 | 11.11 | 9.02 | 2.91 | 8.99 | 6.65 | 8.69 | 23.03 | 25.69 | 7.94 | 6.21 | 3.07 | 17.31 | 2.80 | 20.68 | 47.51 | 22.26 | 9.75 | 4.66 | 2.95 | 12.94 | 15.32 | 13.89 | 2.59 | 2.22 | | 83.79 | 5.59 | 3.07 | 558.60 |
| KI | 35.68 | 17.25 | 35.68 | 4.54 | 9.47 | 10.99 | 7.76 | 6.06 | 1.95 | 7.11 | 4.46 | 5.83 | 15.16 | 16.90 | 5.35 | 4.16 | 2.06 | 11.57 | 1.87 | 13.51 | 31.03 | 14.85 | 6.52 | 3.12 | 1.97 | 8.61 | 10.19 | 9.27 | 1.73 | 1.48 | | 55.03 | 3.67 | 2.02 | 366.85 |
| WT | 28.79 | 13.92 | 28.79 | 3.66 | 7.72 | 8.95 | 6.11 | 5.18 | 1.60 | 5.84 | 3.65 | 4.78 | 12.31 | 13.73 | 4.35 | 3.41 | 1.69 | 9.47 | 1.53 | 11.01 | 25.29 | 12.16 | 5.34 | 2.55 | 1.62 | 7.04 | 8.34 | 7.60 | 1.41 | 1.21 | | 44.77 | 2.98 | 1.64 | 298.44 |
| RG | 9.17 | 4.43 | 9.17 | 1.17 | 2.48 | 2.90 | 1.99 | 1.62 | 0.55 | 1.91 | 1.19 | 1.56 | 3.98 | 4.44 | 1.41 | 1.11 | 0.55 | 3.08 | 0.50 | 3.57 | 8.20 | 3.96 | 1.74 | 0.83 | 1.53 | 2.29 | 2.72 | 2.48 | 0.46 | 0.40 | | 14.45 | 0.96 | 0.53 | 96.33 |
| JL | 33.31 | 16.11 | 33.31 | 4.23 | 9.07 | 10.60 | 7.29 | 5.94 | 1.92 | 7.34 | 4.38 | 5.73 | 14.55 | 16.23 | 5.17 | 4.07 | 2.02 | 11.32 | 1.84 | 13.06 | 30.00 | 14.56 | 6.40 | 3.06 | 1.94 | 8.42 | 9.97 | 9.11 | 1.70 | 1.45 | | 52.87 | 3.52 | 1.94 | 352.43 |
| MAL | 20.73 | 10.02 | 20.73 | 2.63 | 5.66 | 6.66 | 4.58 | 3.73 | 1.20 | 4.39 | 2.89 | 3.60 | 9.14 | 10.20 | 3.25 | 2.57 | 1.28 | 7.13 | 1.16 | 8.23 | 18.91 | 9.17 | 4.03 | 1.93 | 1.22 | 5.30 | 6.28 | 5.73 | 1.07 | 0.92 | | 33.14 | 2.21 | 1.22 | 220.91 |
| KDW | 27.43 | 13.26 | 27.43 | 3.49 | 7.43 | 8.69 | 5.96 | 4.85 | 1.57 | 4.84 | 3.58 | 4.89 | 12.00 | 13.38 | 4.23 | 3.33 | 1.65 | 9.26 | 1.50 | 10.71 | 24.60 | 11.90 | 5.23 | 2.50 | 1.58 | 6.88 | 8.15 | 7.44 | 1.38 | 1.19 | | 43.20 | 2.88 | 1.58 | 287.99 |
| MD. 1 | 74.63 | 36.09 | 74.63 | 9.49 | 19.03 | 22.73 | 15.04 | 12.21 | 3.93 | 14.36 | 9.00 | 11.77 | 36.33 | 40.52 | 10.80 | 8.40 | 4.16 | 23.43 | 3.78 | 27.70 | 63.63 | 30.10 | 13.19 | 6.30 | 3.99 | 17.47 | 20.69 | 18.77 | 3.50 | 3.00 | | 114.80 | 7.65 | 4.21 | 765.33 |
| MD. 2 | 83.24 | 40.25 | 83.24 | 10.58 | 21.23 | 25.35 | 16.78 | 13.62 | 4.38 | 16.02 | 10.04 | 13.13 | 40.52 | 45.19 | 12.05 | 9.37 | 4.64 | 26.14 | 4.22 | 30.90 | 70.97 | 33.57 | 14.71 | 7.03 | 4.45 | 19.48 | 23.07 | 20.94 | 3.90 | 3.35 | | 128.04 | 8.54 | 4.69 | 853.63 |
| WI | 25.89 | 12.52 | 25.89 | 3.29 | 6.77 | 7.94 | 5.35 | 4.34 | 1.40 | 4.32 | 3.19 | 4.17 | 11.01 | 12.28 | 4.15 | 2.98 | 1.48 | 8.31 | 1.34 | 9.75 | 22.39 | 10.67 | 4.68 | 2.23 | 1.41 | 6.18 | 7.32 | 6.65 | 1.24 | 1.06 | | 39.58 | 2.64 | 1.45 | 263.87 |
| AN | 19.67 | 9.51 | 19.67 | 2.50 | 5.25 | 6.17 | 4.20 | 3.41 | 1.10 | 4.01 | 2.52 | 3.29 | 8.50 | 9.49 | 2.98 | 2.45 | 1.17 | 6.54 | 1.06 | 7.62 | 17.50 | 8.39 | 3.69 | 1.76 | 1.11 | 4.86 | 5.76 | 5.24 | 0.98 | 0.84 | | 30.78 | 2.05 | 1.13 | 205.20 |
| KDL | 9.64 | 4.66 | 9.64 | 1.23 | 2.61 | 3.07 | 2.10 | 1.71 | 0.55 | 2.01 | 1.27 | 1.65 | 4.22 | 4.71 | 1.49 | 1.18 | 0.61 | 3.27 | 0.53 | 3.79 | 8.71 | 4.21 | 1.85 | 0.89 | 0.56 | 2.44 | 2.89 | 2.63 | 0.49 | 0.42 | | 15.29 | 1.02 | 0.56 | 101.90 |
| KX | 54.98 | 26.58 | 54.98 | 6.99 | 14.49 | 17.19 | 11.58 | 9.40 | 3.03 | 11.06 | 6.94 | 9.06 | 23.68 | 26.41 | 8.28 | 6.49 | 3.21 | 18.82 | 2.92 | 21.27 | 48.85 | 23.24 | 10.19 | 4.86 | 3.07 | 13.47 | 15.96 | 14.47 | 2.70 | 2.32 | | 85.64 | 5.71 | 3.14 | 570.98 |
| HC | 8.77 | 4.24 | 8.77 | 1.12 | 2.37 | 2.80 | 1.91 | 1.55 | 0.50 | 1.83 | 1.15 | 1.50 | 3.84 | 4.28 | 1.36 | 1.07 | 0.53 | 2.98 | 0.51 | 3.46 | 7.94 | 3.83 | 1.68 | 0.81 | 0.51 | 2.22 | 2.63 | 2.39 | 0.45 | 0.38 | | 13.90 | 0.93 | 0.51 | 92.72 |
| HK. 1 | 65.37 | 31.61 | 65.37 | 8.31 | 16.98 | 20.45 | 13.54 | 11.00 | 3.54 | 12.95 | 8.12 | 10.60 | 27.77 | 30.97 | 9.67 | 7.57 | 3.75 | 21.14 | 3.42 | 29.55 | 67.88 | 27.24 | 11.92 | 5.69 | 3.60 | 15.85 | 18.77 | 16.97 | 3.16 | 2.71 | | 103.44 | 6.90 | 3.79 | 689.60 |
| HK. 2 | 150.85 | 72.95 | 150.85 | 19.18 | 39.18 | 47.19 | 31.25 | 25.39 | 8.18 | 29.89 | 18.75 | 24.46 | 64.08 | 71.46 | 22.31 | 17.48 | 8.66 | 48.78 | 7.88 | 68.19 | 156.63 | 62.86 | 27.51 | 13.13 | 8.30 | 36.59 | 37.29 | 39.15 | 7.29 | 6.26 | | 237.62 | 15.84 | 8.71 | 1,584.14 |
| ND | 70.23 | 33.96 | 70.23 | 8.93 | 18.59 | 22.14 | 14.90 | 12.11 | 3.90 | 14.26 | 8.95 | 11.67 | 30.33 | 33.82 | 10.63 | 8.35 | 4.14 | 23.30 | 3.77 | 27.59 | 63.39 | 31.26 | 13.17 | 6.27 | 3.97 | 17.51 | 20.73 | 18.70 | 3.48 | 3.00 | | 110.23 | 7.35 | 4.04 | 734.90 |
| MHG | 30.59 | 14.79 | 30.59 | 3.89 | 8.22 | 9.73 | 6.62 | 5.38 | 1.73 | 6.34 | 3.98 | 5.19 | 13.35 | 14.89 | 4.71 | 3.71 | 1.84 | 10.34 | 1.68 | 12.07 | 27.73 | 13.32 | 6.11 | 2.80 | 1.77 | 7.75 | 9.17 | 8.32 | 1.55 | 1.34 | | 48.44 | 3.23 | 1.78 | 322.95 |
| HO | 14.51 | 7.02 | 14.51 | 1.84 | 3.95 | 4.66 | 3.20 | 2.60 | 0.84 | 3.06 | 1.93 | 2.51 | 6.40 | 7.14 | 2.27 | 1.79 | 0.89 | 4.98 | 0.81 | 5.77 | 13.25 | 6.42 | 2.83 | 1.41 | 0.86 | 3.72 | 4.40 | 4.02 | 0.75 | 0.64 | | 23.18 | 1.55 | 0.85 | 154.56 |
| PK | 9.11 | 4.41 | 9.11 | 1.16 | 2.51 | 2.96 | 2.04 | 1.66 | 0.54 | 1.96 | 1.23 | 1.60 | 4.06 | 4.53 | 1.45 | 1.14 | 0.57 | 3.18 | 0.52 | 3.66 | 8.40 | 4.10 | 1.80 | 0.87 | 0.57 | 2.37 | 2.81 | 2.57 | 0.48 | 0.41 | | 14.70 | 0.98 | 0.54 | 98.00 |
| MV 1 | 40.97 | 19.81 | 40.97 | 5.21 | 10.90 | 12.98 | 8.76 | 7.12 | 2.30 | 8.39 | 5.26 | 6.87 | 17.72 | 19.77 | 6.24 | 4.91 | 2.43 | 13.68 | 2.22 | 16.14 | 37.09 | 17.66 | 7.74 | 3.69 | 2.33 | 11.20 | 13.27 | 11.03 | 2.05 | 1.76 | | 64.80 | 4.32 | 2.38 | 431.97 |
| MV. 2 | 48.52 | 23.46 | 48.52 | 6.17 | 12.91 | 15.37 | 10.38 | 8.44 | 2.72 | 9.94 | 6.23 | 8.13 | 20.99 | 23.41 | 7.39 | 5.81 | 2.88 | 16.20 | 2.62 | 19.12 | 43.92 | 20.92 | 9.17 | 4.37 | 2.76 | 13.27 | 15.71 | 13.07 | 2.43 | 2.09 | | 76.73 | 5.12 | 2.81 | 511.58 |
| MF | 43.27 | 20.92 | 43.27 | 5.50 | 11.72 | 13.89 | 9.49 | 7.71 | 2.49 | 9.09 | 5.71 | 7.44 | 19.01 | 21.20 | 6.73 | 5.31 | 2.64 | 14.79 | 2.40 | 17.21 | 39.53 | 19.07 | 8.38 | 4.00 | 2.53 | 11.12 | 13.17 | 12.51 | 2.23 | 1.91 | | 69.07 | 4.60 | 2.53 | 460.44 |
| PYL | 8.11 | 3.92 | 8.11 | 1.03 | 2.19 | 2.60 | 1.77 | 1.44 | 0.46 | 1.70 | 1.07 | 1.39 | 3.56 | 3.97 | 1.26 | 0.99 | 0.49 | 2.48 | 0.45 | 3.22 | 7.39 | 3.56 | 1.57 | 0.75 | 0.47 | 2.07 | 2.46 | 2.24 | 0.43 | 0.36 | | 12.85 | 0.86 | 0.47 | 85.69 |
| BS | 6.97 | 3.37 | 6.97 | 0.89 | 1.87 | 2.22 | 1.50 | 1.22 | 0.39 | 1.44 | 0.90 | 1.18 | 3.03 | 3.38 | 1.07 | 0.84 | 0.42 | 2.35 | 0.38 | 2.75 | 6.32 | 3.03 | 1.33 | 0.63 | 0.40 | 1.77 | 2.09 | 1.89 | 0.35 | 0.32 | | 11.02 | 0.73 | 0.40 | 73.42 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| STD | 299.99 | 145.07 | 299.99 | 38.13 | 71.14 | 83.79 | 55.03 | 44.77 | 14.45 | 52.87 | 33.14 | 43.20 | 114.80 | 128.04 | 39.58 | 30.78 | 15.29 | 85.64 | 13.90 | 103.44 | 237.62 | 110.23 | 48.44 | 23.18 | 14.70 | 64.80 | 76.73 | 69.07 | 12.85 | 11.02 | | | | | 2,381.68 |
| ISD | 100.00 | 48.36 | 100.00 | 12.71 | 4.74 | 5.59 | 3.67 | 2.98 | 0.96 | 3.52 | 2.21 | 2.88 | 7.65 | 8.54 | 2.64 | 2.05 | 1.02 | 5.71 | 0.93 | 6.90 | 15.84 | 7.35 | 3.23 | 1.55 | 0.98 | 4.32 | 5.12 | 4.60 | 0.86 | 0.73 | | | | | 367.64 |
| SPL | 11.00 | 5.32 | 11.00 | 1.40 | 2.61 | 3.07 | 2.02 | 1.64 | 0.53 | 1.94 | 1.22 | 1.58 | 4.21 | 4.69 | 1.45 | 1.13 | 0.56 | 3.14 | 0.51 | 3.79 | 8.71 | 4.04 | 1.78 | 0.85 | 0.54 | 2.38 | 2.81 | 2.53 | 0.47 | 0.40 | | | | | 87.32 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL | 2,072.14 | 1,002.00 | 2,072.14 | 263.42 | 459.09 | 544.34 | 361.83 | 293.99 | 94.69 | 343.02 | 216.99 | 283.31 | 752.58 | 839.37 | 258.76 | 202.16 | 100.21 | 563.39 | 91.16 | 680.35 | 1,562.83 | 725.57 | 318.01 | 151.86 | 96.10 | 423.54 | 495.52 | 452.93 | 84.27 | 72.31 | | 2,381.68 | 367.64 | 87.32 | 18,714.52 |

In the calculation, loss probability of 0.01 in Erlang B Table is applied to direct circuits, whereas for high usage circuits and outgoing circuits from tandem exchange the formula given in CCITT Manual "Local Network Planning 1979" is used.

Formulas are as under:

1) High Usage Circuit

$$A_{ij}[E(n_{ij}, A_{ij}) - E(n_{ij} + 1, A_{ij})]$$
$$= e_{ij}[1-0.3 \quad (1-e_{ij}{}^{2})]$$

where

$E$ : Loss probability

$A_{ij}$ : Traffic from Exchange i to Exchange j

$e_{ij}$ : Cost ratio

$$e_{ij} = \frac{B_{ij}}{B_{ik} + B_{kj}}$$

$B_{ik}$ : Cost of junction between Exchange i and Tandem Exchange

$B_{kj}$ : Cost of junction between Tandem Exchange and Exchange j

$B_{ij}$ : Cost of junction between Exchange i and Exchange j

The minimum number of high usage circuits is to be 15.

2) Final Circuit

$$P_{ij} = A_{ij} \times E\ (n_{ij}, A_{ij})$$

$$V_{ij} = P_{ij}\ (1 - P_{ij} + \frac{A_{ij}}{n_{ij} + 1 + P_{ij} - A_{ij}})$$

$$M_{ik} = \sum_{j} P_{ij} \qquad V_{ik} = \sum_{j} V_{ij}$$

$$M_{kj} = \sum_{i} P_{ij} \qquad V_{kj} = \sum_{i} V_{ij}$$

where

$P_{ij}$ : Mean value of traffic rejected from each high usage route

$V_{ij}$ : Variance of traffic rejected from each high usage route

$M_{ik}$ : Mean value of traffic offered to final circuit

$M_{kj}$ : Mean value of traffic offered to circuit from Tandem Exchange to Exchange j

$$A^* = V + 3\ \frac{V}{M}\ (\frac{V}{M} - 1)$$

$$n^* = \frac{A^*}{q} - M - 1$$

$$q = 1 - \frac{1}{M + \frac{V}{M}}$$

$$A^* \times E(n^* + m, A^*) = EO \times M$$

where

A* : Equivalent traffic to final circuit

n* : Equivalent number of circuits to final circuit

m : Final circuit required

EO : Loss probability on tandem route

The exchange by exchange breakdown of the number of junction circuits required is given in Table 5-6.

(2) Between Master Exchange and Remote Switching Unit (RSU)

On the junction circuit between master exchange and RSU, all originating/terminating traffic to/from RSU including its intra-office calls flows.

The number of subscribers to be accommodated in each RSU is restricted by both the terminal capacity and the traffic capacity of the RSU.

The number of PCM system between master exchange and RSU depends upon the latter's unit formation of RSU.

Each E10-B RSU equipment can have four, three or two PCM links. These PCM links respectively hold 100 Erl., 72.5 Erl. and 46 Erl. traffic capacities.

Out of the subscriber lines to be accommodated in RSU, public telephone and other special service lines can be accommodated only in half the number of ordinary subscriber lines. This is by reason of PCB board construction. Such special service lines presently accommodated are about 4% of all subscriber lines.

Table 5-7 indicates the limit of subscriber accommodation per RSU in the case of traffic capacity of 100 Erl. and in consideration of 4% decrease due to special service line accommodation.

Table 5-8 presents the exchange by exchange and year by year breakdown of the number of RSU and PCM links required.

(3) Number of Telephone Junction Circuits

Outgoing and incoming circuits between digital exchanges are inevitably to be PCM circuits. At Mt. Lavinia Exchange equipped with analogue switches also, outgoing and incoming circuits are to be PCM circuits from the viewpoint of transmission loss distribution.

The number of PCM systems required between master exchanges can be obtained from the number of circuits calculated in paragraph (1) above.

As for the junction circuits between master exchange and RSU, the number of PCM systems is determined by the traffic volume and the number of terminals at the RSU as per the calculation in paragraph (2).

The year by year totals of PCM systems applied to junction cables are as under:

| Year | No. of PCM Systems |
|---|---|
| 1987 | 328 |
| 1992 | 566 |
| 1997 | 813 |
| 2002 | 1,226 |

(4) Miscellaneous Circuits

Miscellaneous circuits include telex, telegraphy and other leased circuits.

The number required of these circuits will be in proportion to the degree of economic and social activities of the area concerned. In other words, the number of miscellaneous circuits is considered to be proportioned to the degree of telephone circuits.

As of the present, in the Greater Colombo Area, about 7.6% of telephone circuits in junction sections between master exchanges and about 1.6% in the sections between RSU and Colombo Central exchange are miscellaneous circuits.

Therefore, in the circuit grouping, this time, 10% of telephone circuits in junction sections interconnecting Kelaniya, Colombo Central, Maradana, Havelock Town and Mt. Lavinia master exchanges and 5% in other junction sections are to be reserved for miscellaneous circuits. However, out of miscellaneous circuits, telex circuits between master exchanges are to be concentrated by VFT.

Furthermore, since RSU can accommodate 46 telex circuits per PCM system, telex circuits between RSU and master exchange are to be concentrated by RSU or by VFT.

Table 5-6 (1/4) Number of Junction Circuits as of 1987

| FROM \ TO | CO. 1 | CO. 2 | CO. 3 | CO. 4 | MTK | KPT | KI | WT | RG | JL | MAL | KDW | MD. 1 | MD. 2 | WI | AN | KDL | KX | HC | HK. 1 | HK. 2 | ND | MHG | HO | PK | MV. 1 | MV. 2 | MF | PYL | BS | TDM | STD | ISD | SPL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO I | | 232 | | | | | | | | | | | 260 | | | | | | | 307 | | | | | | 98 | | | | | | 266 | 98 | 17 | 1,278 |
| CO. 2 | 247 | | | | | | | | | | | | 179 | | | | | | | 212 | | | | | | 69 | | | | | | 157 | 24 | 11 | 899 |
| CO. 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CO. 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MTK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KPT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KI | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| JL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KDW | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MD. 1 | 280 | 179 | | | | | | | | | | | | | | | | | | 254 | | | | | | 82 | | | | | | 186 | 19 | 13 | 1,013 |
| MD. 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WI | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KDL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HK. 1 | 327 | 213 | | | | | | | | | | | 256 | | | | | | | | | | | | | 98 | | | | | | 220 | 22 | 14 | 1,150 |
| HK. 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ND | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MHG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MV. 1 | 104 | 70 | | | | | | | | | | | 83 | | | | | | | 99 | | | | | | | | | | | | 72 | 10 | 7 | 445 |
| MV. 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PYL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TDM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| STD | 266 | 157 | | | | | | | | | | | 186 | | | | | | | 220 | | | | | | 72 | | | | | | | | | 901 |
| ISD | 98 | 24 | | | | | | | | | | | 19 | | | | | | | 22 | | | | | | 10 | | | | | | | | | 173 |
| SPL | 17 | 11 | | | | | | | | | | | 13 | | | | | | | 14 | | | | | | 7 | | | | | | | | | 62 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL | 1,339 | 886 | | | | | | | | | | | 996 | | | | | | | 1,128 | | | | | | 436 | | | | | | 901 | 173 | 62 | 5,921 |

Table 5-6 (2/4) Number of Junction Circuits as of 1992

| TO / FROM | CO. 1 | CO. 2 | CO. 3 | CO. 4 | MTK | KPT | KI | WT | RG | JL | MAL | KDW | MD. 1 | MD. 2 | WI | AN | KDL | KX | HC | HK. 1 | HK. 2 | ND | MHG | HO | PK | MV 1 | MV. 2 | MF | PYL | BS | TDM | STD | ISD | SPL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO. 1 | | 298 | | | | | 128 | | | | | | 278 | | | | | | | 307 | | | | | | 94 | 77 | | | | 52 | 324 | 117 | 19 | 1,694 |
| CO. 2 | 309 | | | | | | 89 | | | | | | 193 | | | | | | | 213 | | | | | | 65 | 53 | | | | 44 | 210 | 55 | 14 | 1,245 |
| CO. 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CO. 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MTK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KPT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KI | 137 | 92 | | | | | | | | | | | 114 | | | | | | | 126 | | | | | | 39 | 32 | | | | 44 | 115 | 13 | 9 | 721 |
| WT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| JL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KDW | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MD. 1 | 304 | 202 | | | | | 113 | | | | | | | | | | | | | 274 | | | | | | 84 | 69 | | | | 54 | 240 | 24 | 15 | 1,379 |
| MD. 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WI | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KDL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HK. 1 | 331 | 222 | | | | | 126 | | | | | | 276 | | | | | | | | | | | | | 98 | 80 | | | | 56 | 267 | 26 | 17 | 1,499 |
| HK. 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ND | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MHG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MV. 1 | 98 | 65 | | | | | 39 | | | | | | 86 | | | | | | | 98 | | | | | | | 31 | | | | 39 | 88 | 11 | 8 | 563 |
| MV. 2 | 81 | 55 | | | | | 32 | | | | | | 70 | | | | | | | 81 | | | | | | 32 | | | | | 33 | 73 | 10 | 7 | 474 |
| MF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PYL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TDM | 55 | 46 | | | | | 43 | | | | | | 54 | | | | | | | 55 | | | | | | 35 | 30 | | | | | | | | 318 |
| STD | 324 | 210 | | | | | 115 | | | | | | 240 | | | | | | | 267 | | | | | | 88 | 73 | | | | | | | | 1,317 |
| ISD | 117 | 55 | | | | | 13 | | | | | | 24 | | | | | | | 26 | | | | | | 11 | 10 | | | | | | | | 256 |
| SPL | 19 | 14 | | | | | 9 | | | | | | 15 | | | | | | | 17 | | | | | | 8 | 7 | | | | | | | | 89 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL | 1,775 | 1,259 | | | | | 707 | | | | | | 1,350 | | | | | | | 1,464 | | | | | | 554 | 462 | | | | 322 | 1,317 | 256 | 89 | 9,555 |

Table 5-6 (3/4) Number of Junction Circuits as of 1997

| FROM \ TO | CO. 1 | CO. 2 | CO. 3 | CO. 4 | MTK | KPT | KI | WT | RG | JL | MAL | KDW | MD. 1 | MD. 2 | WI | AN | KDL | KX | HC | HK. 1 | HK. 2 | ND | MHG | HO | PK | MV. 1 | MV. 2 | MF | PYL | BS | TDM | STD | ISD | SPL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO. 1 | | 337 | 121 | | | | 128 | | | | | | 271 | | | | | | | 271 | 64 | | | | | 61 | 90 | | | | 53 | 324 | 117 | 19 | 1,856 |
| CO. 2 | 349 | | 113 | | | | 138 | | | | | | 293 | | | | | | | 294 | 69 | | | | | 66 | 93 | | | | 55 | 324 | 83 | 19 | 1,896 |
| CO. 3 | 121 | 109 | | | | | 40 | | | | | | 84 | | | | | | | 84 | 20 | | | | | 19 | 28 | | | | 31 | 105 | 41 | 9 | 691 |
| CO. 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MTK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KPT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KI | 137 | 128 | 43 | | | | | | | | | | 152 | | | | | | | 154 | 36 | | | | | 35 | 52 | | | | 52 | 156 | 17 | 11 | 973 |
| WT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| JL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KDW | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MD. 1 | 295 | 306 | 91 | | | | 146 | | | | | | | | | | | | | 326 | 77 | | | | | 74 | 109 | | | | 67 | 321 | 30 | 19 | 1,861 |
| MD. 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WI | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KDL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HK. 1 | 292 | 305 | 90 | | | | 154 | | | | | | 328 | | | | | | | | 92 | | | | | 78 | 114 | | | | 61 | 324 | 30 | 19 | 1,887 |
| HK. 2 | 69 | 72 | 22 | | | | 36 | | | | | | 77 | | | | | | | 92 | | | | | | 19 | 28 | | | | 32 | 83 | 11 | 7 | 548 |
| ND | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MHG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MV. 1 | 66 | 69 | 21 | | | | 35 | | | | | | 75 | | | | | | | 79 | 20 | | | | | | 34 | | | | 35 | 80 | 10 | 7 | 531 |
| MV. 2 | 96 | 101 | 30 | | | | 52 | | | | | | 111 | | | | | | | 115 | 28 | | | | | 34 | | | | | 42 | 114 | 13 | 9 | 745 |
| MF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PYL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TDM | 54 | 55 | 31 | | | | 56 | | | | | | 63 | | | | | | | 62 | 32 | | | | | 36 | 41 | | | | | | | | 430 |
| STD | 324 | 324 | 105 | | | | 156 | | | | | | 321 | | | | | | | 324 | 83 | | | | | 80 | 114 | | | | | | | | 1,831 |
| ISD | 117 | 83 | 41 | | | | 17 | | | | | | 30 | | | | | | | 30 | 11 | | | | | 10 | 13 | | | | | | | | 352 |
| SPL | 19 | 19 | 9 | | | | 11 | | | | | | 19 | | | | | | | 19 | 7 | | | | | 7 | 9 | | | | | | | | 119 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL | 1,939 | 1,908 | 717 | | | | 969 | | | | | | 1,824 | | | | | | | 1,850 | 539 | | | | | 519 | 725 | | | | 428 | 1,831 | 352 | 119 | 13,720 |

Table 5-6 (4/4) Number of Junction Circuits as of 2002

| FROM \ TO | CO. 1 | CO. 2 | CO. 3 | CO. 4 | MTK | KPT | KI | WT | RG | JL | MAL | KDW | MD. 1 | MD. 2 | WI | AN | KDL | KX | HC | HK 1 | HK 2 | ND | MHG | HO | PK | MV. 1 | MV. 2 | MF | PYL | BS | TDM | STD | ISD | SPL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO. 1 | | 232 | 267 | 43 | | | 158 | | | | | | 193 | 85 | | | | | | 192 | 151 | | | | | 43 | 110 | | | | 54 | 324 | 117 | 19 | 1,988 |
| CO. 2 | 242 | | 242 | 39 | | | 172 | | | | | | 213 | 94 | | | | | | 212 | 167 | | | | | 48 | 121 | | | | 57 | 324 | 73 | 19 | 2,023 |
| CO. 3 | 267 | 232 | | 43 | | | 158 | | | | | | 193 | 85 | | | | | | 192 | 151 | | | | | 43 | 110 | | | | 54 | 324 | 117 | 19 | 1,988 |
| CO. 4 | 43 | 38 | 43 | | | | 22 | | | | | | 27 | | | | | | | 27 | 21 | | | | | | 15 | | | | 36 | 51 | 21 | 6 | 350 |
| MTK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KPT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KI | 167 | 178 | 167 | 24 | | | | | | | | | 191 | 83 | | | | | | 191 | 148 | | | | | 43 | 109 | | | | 70 | 266 | 26 | 17 | 1,680 |
| WT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| JL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KDW | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MD. 1 | 208 | 219 | 208 | 29 | | | 189 | | | | | | | 115 | | | | | | 234 | 184 | | | | | 53 | 134 | | | | 65 | 324 | 30 | 19 | 2.011 |
| MD. 2 | 87 | 91 | 87 | | | | 76 | | | | | | 114 | | | | | | | 97 | 74 | | | | | 21 | 51 | | | | 77 | 147 | 16 | 11 | 949 |
| WI | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KDL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HK. 1 | 204 | 216 | 204 | 29 | | | 190 | | | | | | 234 | 102 | | | | | | | 201 | | | | | 56 | 138 | | | | 63 | 324 | 30 | 19 | 2,010 |
| HK. 2 | 163 | 172 | 163 | 23 | | | 148 | | | | | | 184 | 81 | | | | | | 201 | | | | | | 44 | 103 | | | | 57 | 260 | 25 | 16 | 1,640 |
| ND | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MHG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MV. 1 | 46 | 49 | 46 | | | | 43 | | | | | | 54 | 24 | | | | | | 56 | 45 | | | | | | 39 | | | | 40 | 80 | 10 | 7 | 539 |
| MV. 2 | 116 | 124 | 116 | 16 | | | 110 | | | | | | 135 | 59 | | | | | | 139 | 110 | | | | | 40 | | | | | 56 | 190 | 20 | 13 | 1.244 |
| MF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PYL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TDM | 60 | 60 | 60 | 37 | | | 72 | | | | | | 66 | 50 | | | | | | 64 | 59 | | | | | 40 | 59 | | | | | | | | 627 |
| STD | 324 | 324 | 324 | 51 | | | 266 | | | | | | 324 | 147 | | | | | | 324 | 260 | | | | | 80 | 190 | | | | | | | | 2.614 |
| ISD | 117 | 73 | 117 | 21 | | | 26 | | | | | | 30 | 16 | | | | | | 30 | 25 | | | | | 10 | 20 | | | | | | | | 485 |
| SPL | 19 | 19 | 19 | 6 | | | 17 | | | | | | 19 | 11 | | | | | | 19 | 16 | | | | | 7 | 13 | | | | | | | | 165 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL | 2,063 | 2,027 | 2,063 | 361 | | | 1,647 | | | | | | 1,977 | 952 | | | | | | 1,978 | 1,612 | | | | | 528 | 1.212 | | | | 629 | 2.614 | 485 | 165 | 20.313 |

Table 5-7 Maximum Number of Subscribers to be Accomodated in One RSU

| Originating calling rate | Max-Number of Subscribers including 4% allowance |
|---|---|
| 0.028 | 983 |
| 0.036 | 983 |
| 0.044 | 983 |
| 0.048 | 983 |
| 0.052 | 923 |
| 0.056 | 856 |
| 0.060 | 800 |
| 0.064 | 750 |
| 0.068 | 706 |
| 0.072 | 666 |
| 0.076 | 631 |

Table 5-8 (1/4) Required Number of RSUs and PCM Links as of 1987

| EX. | No. of Sub. | CR | No. of RSU | | | No. of PCM Links |
|---|---|---|---|---|---|---|
| | | | 4 PCM | 3 PCM | 2 PCM | |
| MTK | 2,200 | 0.064 | 3 | - | - | 12 |
| KPT | 3,250 | 0.064 | 4 | - | 1 | 18 |
| KI | 2,320 | 0.052 | 2 | 1 | - | 11 |
| WT | 1,810 | 0.052 | 2 | - | - | 8 |
| RG | 530 | 0.044 | - | 1 | - | 3 |
| JL | 1,500 | 0.052 | 1 | 1 | - | 7 |
| MAL | 950 | 0.044 | 1 | - | - | 4 |
| KDW | 1,200 | 0.052 | 1 | - | 1 | 6 |
| WI | 1,250 | 0.052 | 1 | - | 1 | 6 |
| AN | 870 | 0.052 | 1 | - | - | 4 |
| KDL | 500 | 0.044 | - | - | 1 | 2 |
| KX | 4,420 | 0.052 | 4 | - | 1 | 18 |
| HC | 430 | 0.044 | - | - | 1 | 2 |
| ND | 5,410 | 0.036 | 5 | - | 1 | 22 |
| MHG | 2,060 | 0.052 | 2 | - | 1 | 10 |
| HO | 790 | 0.044 | - | 1 | - | 3 |
| PK | 410 | 0.044 | - | - | 1 | 2 |
| MF | 3,320 | 0.052 | 3 | - | 1 | 14 |
| PYL | 530 | 0.044 | - | 1 | - | 3 |
| BS | 930 | 0.052 | 1 | - | - | 4 |

Table 5-8 (2/4) Required Number of RSUs and PCM Links as of 1992

| EX. | No. of Sub. | CR | No. of RSU | | | No. of PCM Links |
|---|---|---|---|---|---|---|
| | | | 4 PCM | 3 PCM | 2 PCM | |
| MTK | 3,990 | 0.060 | 5 | - | - | 20 |
| KPT | 4,130 | 0.068 | 6 | - | - | 24 |
| WT | 3,060 | 0.044 | 3 | - | 1 | 14 |
| RG | 1,060 | 0.036 | 1 | - | 1 | 6 |
| JL | 3,100 | 0.044 | 3 | - | 1 | 14 |
| MAL | 2,060 | 0.036 | 2 | - | 1 | 10 |
| KDW | 2,230 | 0.044 | 2 | - | 1 | 10 |
| WI | 2,350 | 0.044 | 2 | - | 1 | 10 |
| AN | 1,510 | 0.044 | 1 | 1 | - | 7 |
| KDL | 1,030 | 0.036 | 1 | - | 1 | 6 |
| KX | 6,700 | 0.044 | 6 | 1 | - | 27 |
| HC | 920 | 0.036 | - | 1 | - | 3 |
| ND | 8,450 | 0.044 | 8 | 1 | - | 35 |
| MHG | 3,150 | 0.044 | 3 | 1 | - | 15 |
| HO | 1,770 | 0.036 | 1 | 1 | - | 7 |
| PK | 1,040 | 0.036 | 1 | - | 1 | 6 |
| MF | 5,080 | 0.044 | 5 | - | 1 | 22 |
| PYL | 1,120 | 0.036 | 1 | - | 1 | 6 |
| BS | 1,200 | 0.044 | 1 | - | 1 | 6 |

Table 5-8 (3/4) Required Number of RSUs and PCM Links as of 1997

| Ex. | No. of Sub. | CR | No. of RSU | | | No. of PCM Links |
|---|---|---|---|---|---|---|
| | | | 4 PCM | 3 PCM | 2 PCM | |
| MTK | 6,700 | 0.056 | 8 | - | - | 32 |
| KPT | 5,950 | 0.072 | 9 | - | - | 36 |
| WT | 4,900 | 0.036 | 4 | 1 | - | 19 |
| RG | 1,820 | 0.028 | 1 | 1 | - | 7 |
| JL | 5,220 | 0.036 | 5 | - | 1 | 22 |
| MAL | 4,000 | 0.028 | 4 | - | 1 | 18 |
| KDW | 4,320 | 0.036 | 4 | - | 1 | 18 |
| WI | 4,110 | 0.036 | 4 | - | 1 | 18 |
| AN | 3,170 | 0.036 | 3 | - | 1 | 14 |
| KDL | 1,880 | 0.028 | 1 | 1 | - | 7 |
| KX | 10,520 | 0.036 | 10 | 1 | - | 43 |
| HC | 1,730 | 0.028 | 1 | - | 1 | 6 |
| ND | 12,620 | 0.048 | 13 | - | - | 52 |
| MHG | 5,450 | 0.036 | 5 | - | 1 | 22 |
| HO | 2,820 | 0.028 | 2 | 1 | - | 11 |
| PK | 1,680 | 0.028 | 1 | - | 1 | 6 |
| MF | 8,340 | 0.036 | 8 | - | 1 | 34 |
| PYL | 1,650 | 0.028 | 1 | - | 1 | 6 |
| BS | 1,550 | 0.036 | 1 | - | 1 | 6 |

Table 5-8 (4/4) Required Number of RSUs and PCM Links as of 2002

| EX. | No. of Sub. | CR | No. of RSU | | | No. of PCM Links |
|---|---|---|---|---|---|---|
| | | | 4 PCM | 3 PCM | 2 PCM | |
| MTK | 9,120 | 0.052 | 10 | - | - | 40 |
| KPT | 7,350 | 0.076 | 11 | 1 | - | 47 |
| WT | 8,290 | 0.036 | 8 | - | 1 | 34 |
| RG | 3,440 | 0.028 | 3 | - | 1 | 14 |
| JL | 9,790 | 0.036 | 9 | 1 | - | 39 |
| MAL | 7,890 | 0.028 | 8 | - | 1 | 34 |
| KDW | 8,000 | 0.036 | 8 | - | 1 | 34 |
| WI | 7,330 | 0.036 | 7 | - | 1 | 30 |
| AN | 5,700 | 0.036 | 5 | 1 | - | 23 |
| KDL | 3,640 | 0.028 | 3 | - | 1 | 14 |
| KX | 15,860 | 0.036 | 16 | - | 1 | 66 |
| HC | 3,310 | 0.028 | 3 | - | 1 | 14 |
| ND | 15,310 | 0.048 | 15 | 1 | - | 63 |
| MHG | 8,970 | 0.036 | 9 | - | 1 | 38 |
| HO | 5,520 | 0.028 | 5 | - | 1 | 22 |
| PK | 3,500 | 0.028 | 3 | - | 1 | 14 |
| MF | 12,790 | 0.036 | 13 | - | 1 | 54 |
| PYL | 3,060 | 0.028 | 3 | - | 1 | 14 |
| BS | 2,040 | 0.036 | 2 | - | 1 | 10 |

## 5-3 Transmission System

### 5-3-1 Classification

The transmission system that is used in the junction network is generally classified as under:

(1) Analogue Transmission System

1) Non-loaded cable system

2) Loaded cable system

3) FDM system

(2) Digital Transmission System

1) PCM system

2) Coaxial cable system

3) Optical fiber cable system

Each of the above systems is further subdivided by the method of circuit multiplexing.

### 5-3-2 Selection of Optimum System

The transmission system for the junction network is to be selected in consideration of technical and economic requirements, such as:

- Allowable D.C. resistance limit value of switching equipment
- Inter-exchange transmission loss distribution value
- Interface with intra-exchange facilities

In the selection of optimum transmission system, priority goes to the digital transmission system. The reason is that the future transmission system is required to be compatible with ISDN (Integrated Services Digital Network) as a corollary of further advancement of digitalization technology from now forward.

Table 5-9 shows the hierarchy of digital transmission system adopted in leading countries.

(1) Transmission system between digital switching equipments themselves is to be of the digital Transmission system. This is because, first, the digital transmission system does not require the intermediation by A/D converter, CODEC or the like; second, in terms of transmission performance and economic consideration, the digital transmission system commands greater advantage than analogue system.

(2) Transmission system between analogue and digital switching equipments is to be determined after the comprehensive studies of merits and demerits of all the aforementioned systems.

(3) At the time of service-in of the Project, the analogue switches operating in the Greater Colombo Area Telephone Network will be at Mt. Lavinia Exchange (XB-C400) and International Gateway Exchange only. Therefore, in consideration of the transfer to digital network sooner or later as a foregone conclusion, the junction network by digital transmission system is to be formulated.

(4) Circuits by loaded cable system is not to be adopted in the Project.

(5) In the sections where PCM system will be adopted, PCM 30 channels system is to be used so as to correspond with the existing system.

(6) In the sections where optical fiber cable system will be introduced, medium capacity system specifications of Table 5-10 specifications is to be adopted. This is to ease the interface with the existing PCM terminal equipment and because the technical development is presently stabilized for the medium capacity system.

(7) Figure 5-1 presents the conceptual diagram of digital transmission systems.

## 5-4 Junction Network Design Standards

The junction network design standards are based on the existing status of SLTD facilities and the fundamental concept of CADS project. New Technology development trends from now forward are also taken into consideration. With these in the background and after in-depth discussions with SLTD, the design standards have been formulated.

### 5-4-1 Summary

For the junction network design, the undermentioned items are to be carefully studies in their mutual relationships.

1) Type of circuit
2) Transmission loss distribution value
3) D.C. resistance limit value
4) Status of existing facilities
5) Long term improvement plan for roads, bridges, etc.
6) Development trends of new technologies

Table 5-9 Hierarchy of Digital Transmission System

| MUX Step / Country | Primary order | Secondary order | Third order | Fourth order | Fifth order | |
|---|---|---|---|---|---|---|
| Japan | (24) x 4 → <br> 1.544 Mbit/s | (96) x 5 → <br> 6.312 Mbit/s | (480) x 3 → <br> 32.064 Mbit/s | (1440) x 4 → <br> 97.728 Mbit/s | (5760) <br> 397.2 Mbit/s | |
| USA, Canada | (24) x 4 → <br> 1.544 Mbit/s | (96) x 7 → <br> 6.312 Mbit/s | (672) x 6 → <br> 44.736 Mbit/s | (4032) <br> 274.176 Mbit/s | | |
| UK | (30) x 4 → <br> 2.048 Mbit/s | (120) x 14 → <br> 8.448 Mbit/s | | (1680) <br> 120 Mbit/s | | |
| West Germany | (30) x 4 → <br> 2.048 Mbit/s | (120) x 4 → <br> 8.448 Mbit/s | (480) x 3 → <br> 34.368 Mbit/s | (1440) x 4 → <br> 108 Mbit/s | (5760) <br> 442 Mbit/s | |
| France | (30) x 4 → <br> 2.048 Mbit/s | (120) x 4 → <br> 8.448 Mbit/s | (480) x 4 → <br> 34.368 Mbit/s | (1920) <br> 139.264 Mbit/s | | |
| Italy | (30) x 4 → <br> 2.048 Mbit/s | (120) x 4 → <br> 8.448 Mbit/s | (480) x 4 → <br> 34.368 Mbit/s | (1920) x 4 → <br> 139.264 Mbit/s | (7680) <br> 565 Mbit/s | |

( ) : Number of channels in terms of telephone lines

Table 5-10 Specifications of Optical Fiber Cable Transmission System

| Item \ System | 34 M System | | 140 M System |
|---|---|---|---|
| Transmission speed | 34.368 Mbit/s | | 139.264 Mbit/s |
| Transmisson capacity | 480 Ch/Sys | | 1920 Ch/Sys |
| Wave length | 0.85 μm | 1.3 μm | 1.3 μm |
| Maximum Repeater Spacing | 10 km | 20 km | 20 km |
| Optical Fiber Cable | Graded Index Multimode | | Graded Index Multimode |
| Diameter of Fiber Core Outer Core/Inner Core | 125 μm/50 μm | | 125 μm/50 μm |

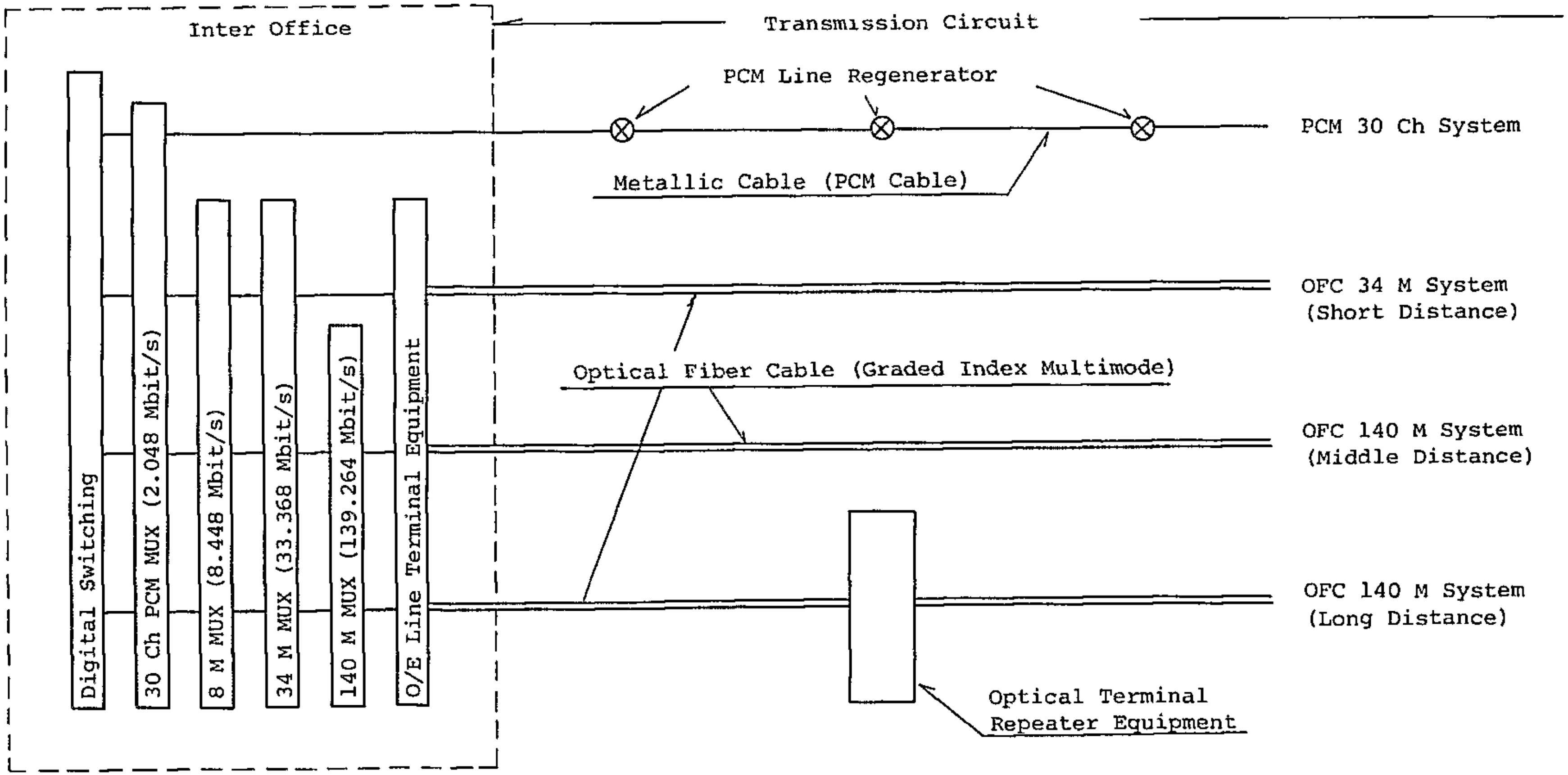



Figure 5-1 Conceptual Diagram of Digital Transmission Network

5-4-2 Route Selection and Cable System Selection

(1) Route Selection

1) For the selection of junction cable route, the undermentioned items are to be studied, based on field survey findirgs and urbanization plans, as well as all associated data. The junction route selected must be the economically advantageous route.

a) Road where the distance between exchanges can be the shortest.

b) Road that is not abolished or modified by urbanization plans an so on.

c) Road that crosses rivers, bridges and/or railway tracks in the least number.

d) Road wide enough not to impede surface traffic seriously during the construction work.

e) Road where the existing underground structures are scarce so that the underground conduit can be easily constructed.

2) Existing Underground Conduit Section

In case the idle duct(s) is available in the existing underground conduit, such idle duct(s) is to be effectively utilized.

In case the existing underground conduit leaves no idle duct, the additional duct is to be built on the existing route or another route is to be newly established. Choice between these two alternatives depends upon the following:

a) Technical restrictions

b) Demand behavior

c) Effect of route duplication on network reliability

In case the additional duct installation does not require manhole remodelling, it is advantageous to build the additional duct on the existing route.

In case another route is newly established, the following advantages can be expected:

a) The location of manhole to accommodate PCM repeater, loading coil, etc. can be selected as initially planned.

b) By the duplication of routes, the network reliability improves.

c) Adaptability to demand fluctuations improves.

3) Existing Direct Buried Cable Section

For installation of additional junction cable in the existing direct buried cable section, the preceding paragraph 2) provisions can apply. However, the underground duct is to be newly installed as far as possible. The purpose is to keep the cable network reliability at a high level.

(2) Cable System Selection

Cable systems are threefold as under. Each system is to be used as specified.

1) Duct Cable System

The duct cable system is for

a) Entrance cable section

b) Main road and section with road traffic congestion

c) Section to cross railway tracks and bridge attachment section

2) Direct Buried Cable System

The direct buried cable system is for

a) Section where road and river improvement, as well as bridge rebuilding, work is expected

b) Section to cross a river where bridge attachment is impractical

3) Aerial Cable System

The aerial cable system is an alternative to apply where neither the duct cable system nor the direct buried cable system is applicable.

### 5-4-3 Junction Cable Design

(1) Provision Period

1) Cable pairs are to be such as to satisfy the circuit requirements 10 years ahead.

   In case the existing cable is available, cable pairs are to be such as to satisfy the remaining circuit requirements after the subtraction of circuits that can be accommodated in the existing cable.

2) In case the existing cable is of the following categories, the replacement with new cable is to be considered:

   a) Cable of extremely high failure rate.

   b) Cable that remains installed for a long time and whose replacement is overdue.

3) The terminal equipment and line repeater capacities are to be large enough to satisfy the demand 5 years ahead. Line repeater housing capacity is to meet with the demand 10 years ahead.

(2) Types of Cable

1) Junction cable to be newly installed is cellular PE insulated, PE sheathed, twin type and screened cable.

   In the direct buried cable section, steel armored cable is to be used.

2) Cable conductor diameters and cable pairs are to be as under.

| Conductor Diameter (mm) | Number of Cable Pairs |
|---|---|
| 0.65 | 14, 30, 50, 72, 100, 150, 200, 300, 400 |
| 0.9 | 14, 30, 50, 72, 100, 150, 200, 300, 400 |

(3) Usage of Cables

1) Integration of junction cable and toll/subscriber cable is not made, in principle.

2) Cable between master exchanges is to be direct cable. Branch cable is not used, in principle.

3) For cable between master exchange and RSU, selection of using branch cable is to be made in consideration of cable configuration.

5-4-4 Underground Duct System Design

(1) Provision period

Provision period of underground duct is to be 20 years (ahead).

(2) Calculation of Required Number of pipes

1) Number of Pipes

The number of pipes is to be the number obtained by multiplying the number of cables by the safety factor, plus the number of spare pipe(s).

2) Number of Spare Pipe(s)

The number of spare pipe(s) is to be determined as specified below, in accordance with the number of cables.

| Number of Cables | Number of Spare Pipe(s) |
|---|---|
| 1 - 15 | 1 |
| 16 - 30 | 2 |
| 31 & over | 3 |

3) Safety Factor

The safety factor is set at 1.2. This safety factor selection reflects the study results about demand situation 20 years ahead, as well as road planning and road network configuration plus road traffic condition and underground structures at that future time.

(3) Pipe

1) Type of Pipe

PVC pipe or steelpipe is to be used.

2) Diameter of Pipe

Diameter of pipe is to be 100 mm in inner diameter.

(4) Location of Duct

In case the carriageway and sidewalk are distinguishable, priority goes to the sidewalk where to construct the duct. Where there is no distriction between carriageway and sidewalk, edge of the road is to chosen for duct construction.

(5) Span between Manholes

Span between manholes is to be determined in consideration of cable branching point and cross-connecting cabinet location, as well as road condition. In no case can the span between manholes exceed the maximum limits specified below.

Straight section: 200 m

Curved section : 100 m

(6) Manhole

Manhole is to be established at cable splicing point, cable branching point, PCM repeater and loading coil locations, and other places for cable system maintenance.

1) The size of manhole is to be determined in consideration of the undermentioned items.

a) Number of pipe(s) required

b) Necessary work space

c) Number of enclosure for cable splicing

d) Number of loading coil

e) Number of line repeater

2) In case where the existing manhole cannot accommodate line repeater and loading coil, either the manhole is to be remodelled or an ad hoc manhole is to be built adjacent to the existing manhole.

3) When determining the identification numbers of manholes to accommodate subscriber cables besides junction cables, the subscriber cable expansion plan is to be taken into consideration.

### 5-4-5 PCM Repeater Spacing Design

(1) Summary

PCM repeater spacing is to be so designed as to satisfy the given bit error rate (BER).

Maximum repeater spacing depends upon the transmission loss and crosstalk of the cable to be used and line repeater gain, as well as the number of PCM systems to be accommodated in the cable at ultimate stage.

Generally, the actual repeater spacing is somewhat shorter than the allowable maximum spacing.

(2) BER (Bit Error Rate)

In PCM transmission system, BER is used as a parameter of repeater characteristic measurement.

CCITT Rec. G912 does not yet provide the recommendation as to the BER objective. According to CCITT SG XV III, the allocation of $1 \times 10^{-6}$ as BER objective on the standard artificial circuit is considered to be appropriate.

(3) Repeater Spacing Design by Scope of Operation of AGC

1) Maximum Repeater Spacing (d Max)

Transmission loss that is allowed to the cable section is subject to restriction by the regeneration repeater gain.

The relationship between maximum transmission loss and maximum repeater spacing at 1,024 kHz in the cable section of PCM 30 channels system is expressed as under:

$$L_o \cdot d\,max = \frac{G}{(1 + \alpha \cdot {}_{\Delta}t)(1 + 3\delta)}$$

where

d max: Maximum repeater spacing (km)

G : Maximum repeater gain (dB)

$\alpha$ : Temperature correction coefficient for transmission loss of cable (/°C)

${}_{\Delta}t$ : Temperature variation range of cable (°C)

$L_o$ : Mean transmission loss of cable at 1,024 kHz, 20°C (dB)

$\delta$ : Conductor by conductor transmission loss variation

2) Exchange Adjacence Section (d End)

In order to reduce the influence of impulsive noise from the exchange, the repeater spacing of the section between PCM multiplex equipment or PCM terminal repeater installed at exchange, on one hand, and the receiving side of adjacent repeater to the exchange is to be shorter than the repeater spacing of other sections.

And, to satisfy the given BER, the transmission loss in that cable section is to be smaller than in the other sections.

(4) Repeater Spacing Restriction due to Inter-System Crosstalk

Repeater spacing in the section except exchange adjacente section is subject to restriction due to crosstalk between systems that exerts an influence on BER.

1) Non-Screened Cable

In case where PCM systems in up and down directions are accommodated in the non-screened cable, the disturbance due to near-end crosstalk between systems in opposite directions is inevitable.

Maximum repeater spacing necessitated by near-end crosstalk can be obtained as under:

$$(M_N + 1.2) - 2.33\ \sigma - (1 + \alpha\ _{\Delta}t)\ (1 + 3\ \delta)\quad Lo\ d$$
$$-(10 \log n + 2.5)\quad S(\varepsilon)$$

where

$M_N$ : Mean near-end crosstalk attenuation at 1,024 kHz (dB)

$\sigma$ : Variation of mean near-end crosstalk attenuation

$S(\varepsilon)$ : Signal to noise ratio at given BER

n : Number of PCM systems

2) Screened Cable

Screened cable is the cable with shielding between systems in up and down directions. This is to reduce the disturbance due to near-end crosstalk between systems in opposite directions, which is the case with general cable.

The relationship between repeater spacing and inter-system crosstalk in case where screened cable is used in the general regeneration section can be expressed by the approximation formula that appears below.

NEXT: $Lo \quad a.[M_N] - b.[\sigma_N] - c.[\log n] - d$

FEXT: $C.[\log(n - 1)] \quad a.[M_F] - b.[\sigma_F] - d'$

where

Lo : Line loss in repeater section (dB)

$M_N$ : Mean near-end crosstalk attenuation at 1,024 kHz (dB)

$M_F$ : Mean far-end crosstalk attenuation at 1,024 kHz (dB)

$\sigma_N$ : Standard deviation of mean near-end crosstalk attenuation at 1,024 kHz

$\sigma_F$ : Standard deviation of mean far-end crosstalk attenuation at 1,024 kHz

(5) Power Supply Design

1) Power supply to line repeaters consists of series supply of D.C. to each system via PCM conductor plantom circuit. This power supply system is illustrated in Figure 5-2.

2) The scope of power supply availability can be obtained as under:

$$d \quad \frac{E - n.V}{(1 + \alpha \ {}_{\Delta}t) \ R \ I}$$

where

d : Power supply distance (km)

E : Supply voltage (V)

I : Supply current (A)

V : Voltage drop for each line repeater (V)

n : Number of line repeaters

R : Phantom loop resistance (ohm/km)

$\alpha$ : Temperature correction coefficient for line resistance (ohm/°C)

${}_{\Delta}t$ : Temperature variation range of cable (°C)

(6) Hot Stand-by System

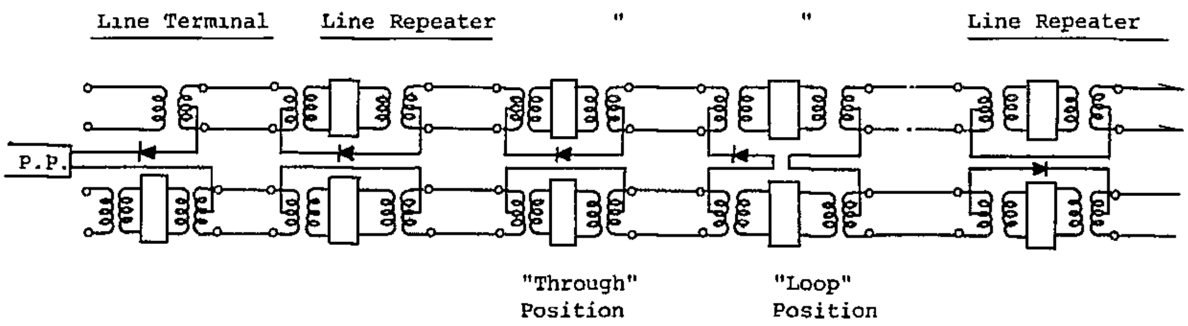
To minimize the circuit failure time on occasion of repeater breakdown, the hot stand-by PCM system is to be established for the whole route. That is to say, one hot stand-by system is to be established for each route regardless of the number of PCM systems accommodated.

Figure 5-3 shows the conceptual diagrams of PCM hot stand-by system.

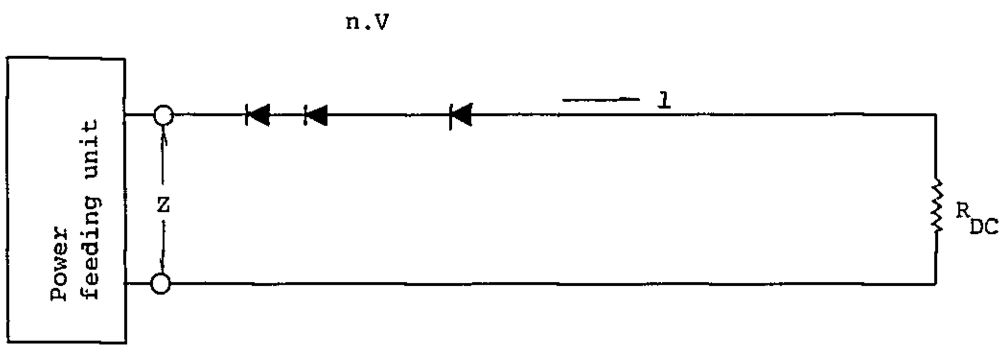
(7) Number of PCM Use Conductors

PCM use conductors comprise conductors for PCM and conductors for maintenance.

Conductors for PCM, two pairs of non-loaded conductors are used for one system because PCM system constitutes the four-wire transmission.




Remote Power Feed Circuit




Equivalent Power Feeding Circuit

Figure 5-2 Remote Power Feeding System

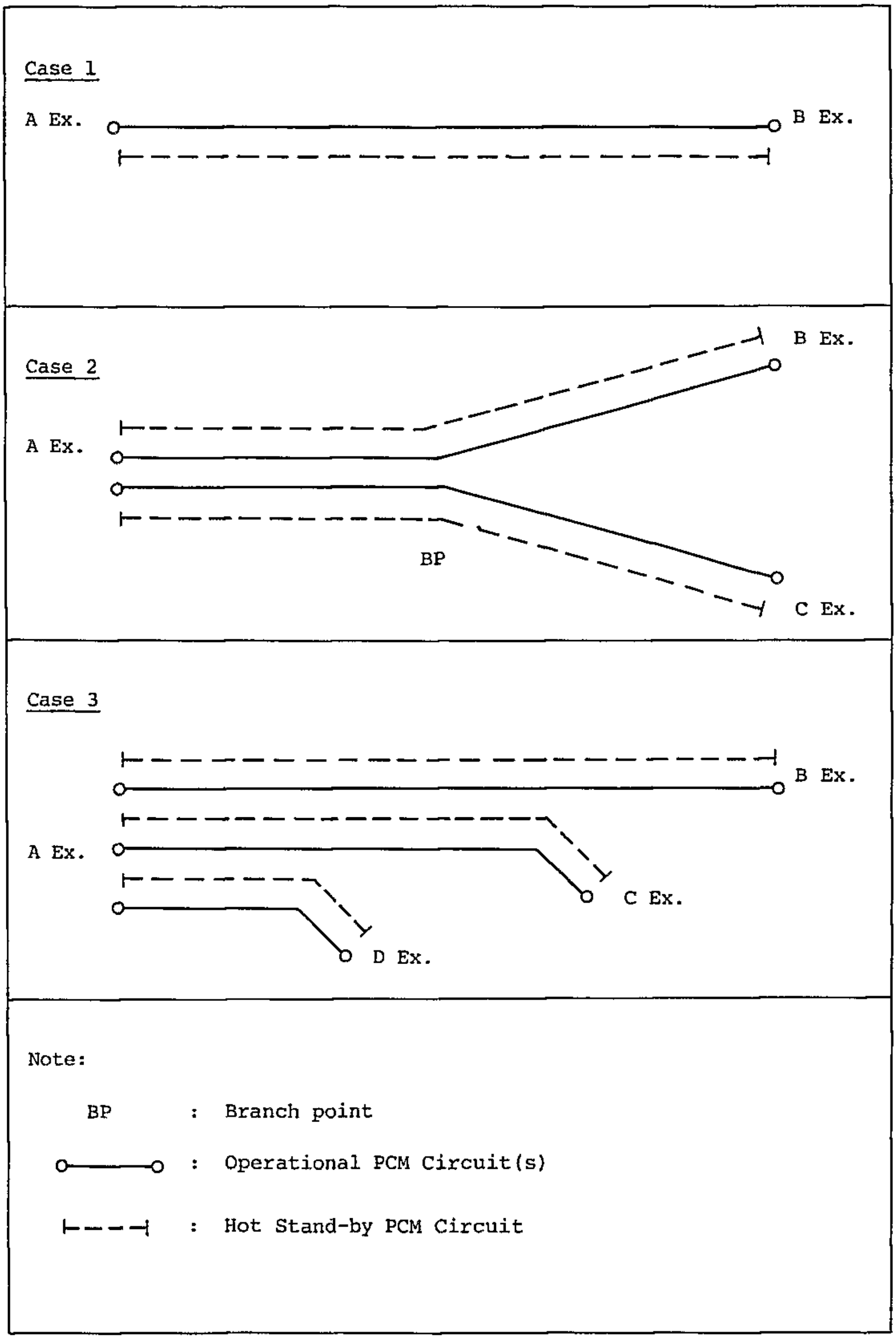



Figure 5-3 Conceptual Diagrams of PCM Hot Stand-by System

Conductors for maintenance include order wire conductors, monitoring conductors for monitoring of repeater and terminal equipment performance, and alarm transmitting conductors. The number of there conductors required varies according to the method of monitoring.

Therefore, the number of PCM use conductors (N) is to be obtained as under:

$$N = 2n + \alpha$$

where

n : Number of PCM systems

$\alpha$ : Number of conductors for maintenance

## 5-5 Basic Design for Greater Colombo Area Junction Cable Network

Based on the result of year by year circuit estimations and groupings, the basic design for junction cable network in the Greater Colombo Area is made. In this basic design, the comments in the paragraphs hereunder are duly considered.

The basic design drawings prepared are:

(1) Junction Cable Route Plan

(2) Junction Cable Network Plan

(3) PCM Repeater spacing

### 5-5-1 How to Handle Existing Junction Cables, etc.

(1) As of 1983, trunk circuits and local circuits are mixed up in some sections. Both these circuits are to be separated by CADS III project.

(2) Out of the existing junction cables, PCQT lead sheathed cables are to be almost withdrawn by CADS III and IV of project.

(3) Out of the cables scheduled to be installed in and after April 1983 by CADS III and IV of project, those with definite installation plans are entered in the basic design drawings as existing cables, with approval of SLTD.

(4) The existing PCQT lead sheathed cables as of 1987, as shown in Figure 5-4, are to be replaced with new cables by the Project, with approval of SLTD.

### 5-5-2 Route Selection

(1) Between the master exchange and RSU, additional cable is to be installed by the existing route in most cases. The reasons are as under:

1) Alternative route is not easily available.

2) The existing route is advantageous for subscriber cable installation. Therefore, additional duct construction in the existing route is preferable economically, because the construction can be carried out at the same time.

(2) For MD Exchange - WI Exchange section and MD Exchange - KX Exchange section. The route selection as shown in Figure 5-5 is available. Actually, the selection is made for the economically advantageous route (B) and route (C), respectively, for the above two sections.

(3) The route formation between master exchanges is shown in Figure 5-6. The reason for selection in each case is as under:

1) CO Exchange - HK Exchange Section
Route (A) is only a little shorter than Route (G), however, in case the selection is made for Route (G), the additional duct construction in the direction to Section (C) can be carried out at the same time. This is economically advantageous. Route (G) is selected for this section.

2) CO Exchange - MD Exchange Section

Route (H) is much shorter in distance than Route (B), and by the scattering of routes, the junction network reliability improves. Route (H) is selected for this section.

3) CO Exchange -KI Exchange Section

No alternative route to allow comparison is available. Route (D) is selected for this section.

4) HK Exchange - MD Exchange Section and
HK Exchange - MV Exchange Section

The existing cable satisfies the required demand size 10 years ahead.

5) CO Exchange - MV Exchange Section

Route (I) is a little longer in distance than route (C) , however, by the scattering of routes, the junction network reliability improves. Route (I) is selected for this section.

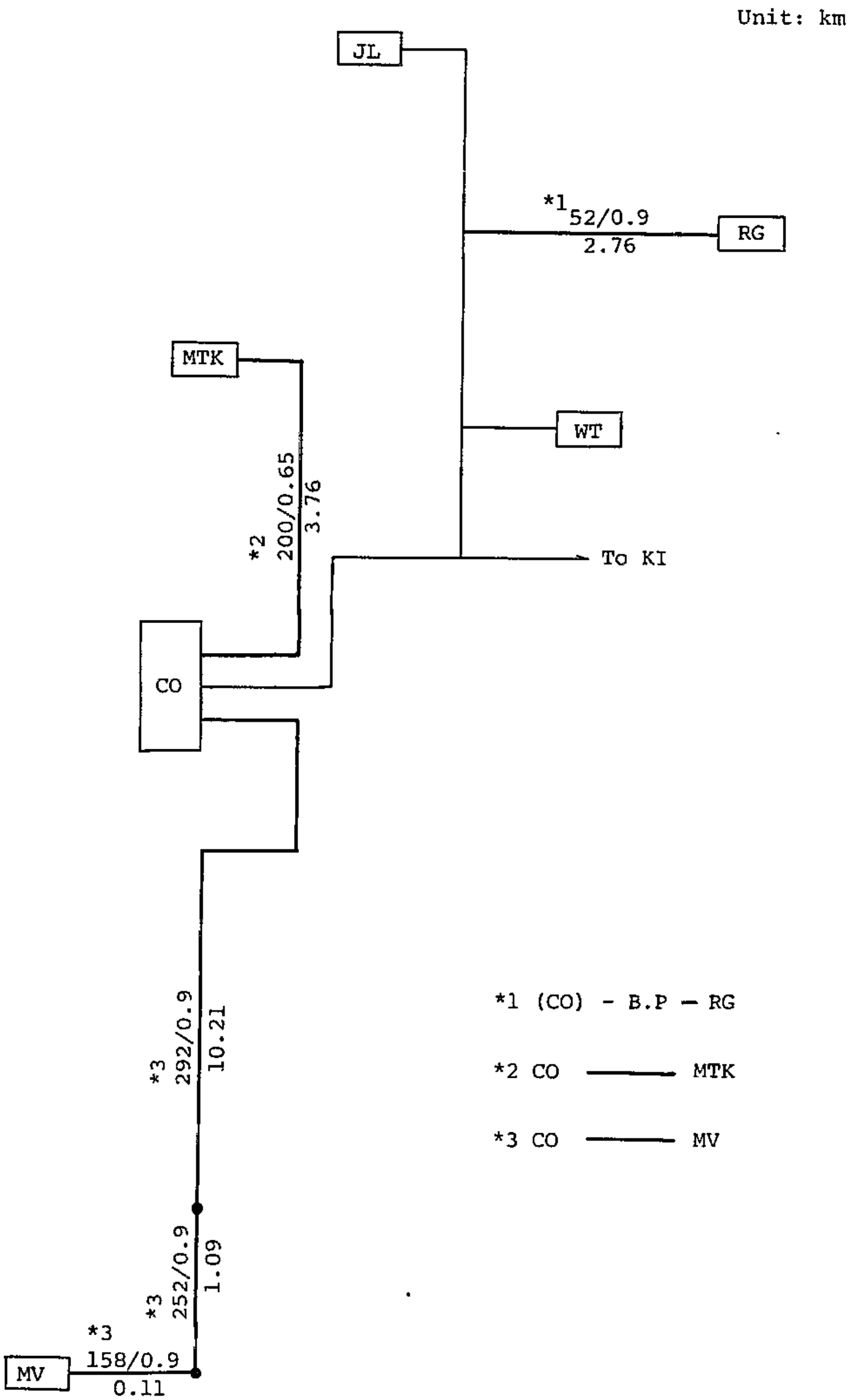



Figure 5-4 Existing PCQT Cable Route as of 1987

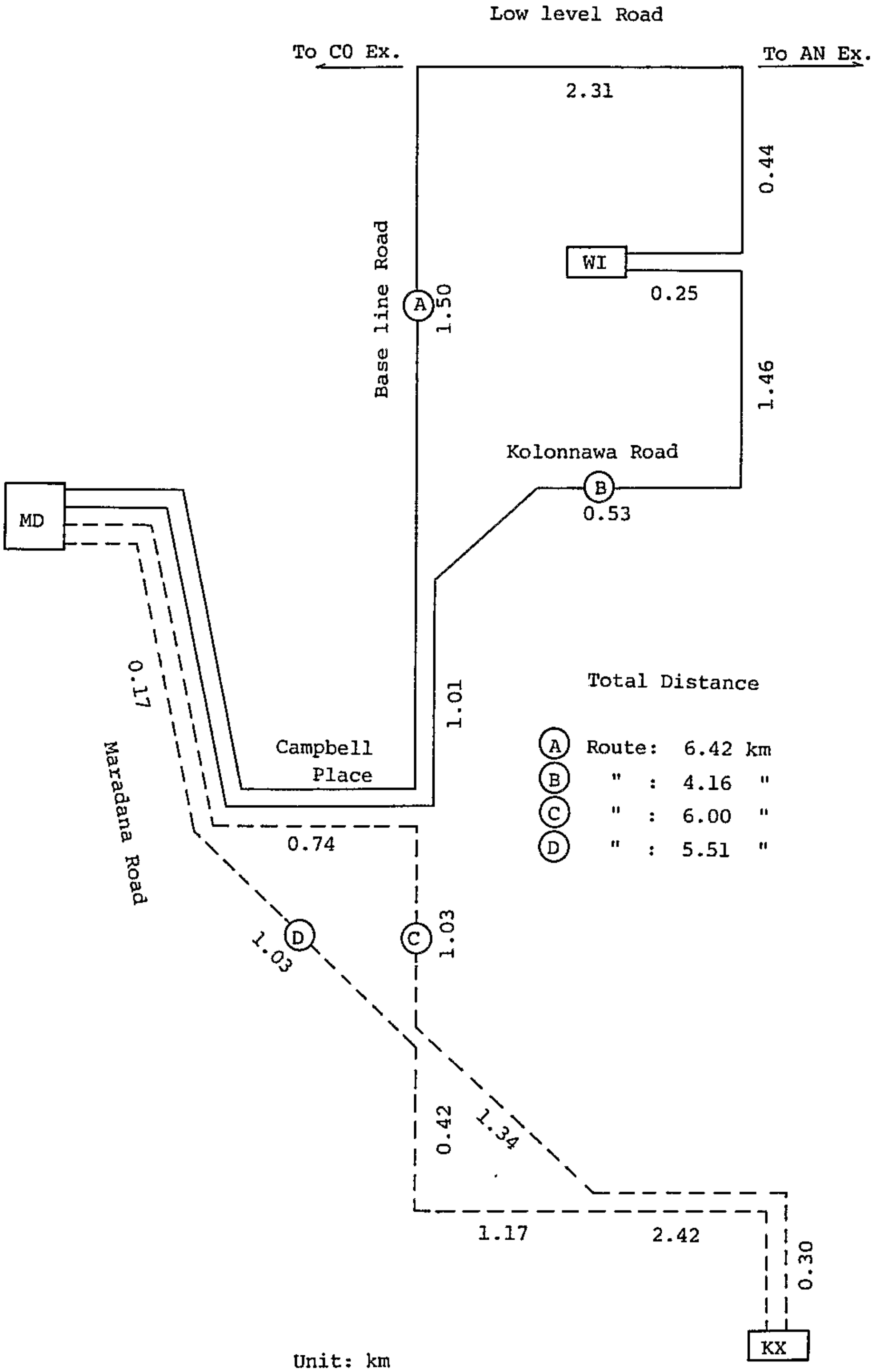



Figure 5-5 Diagram of Route Selection

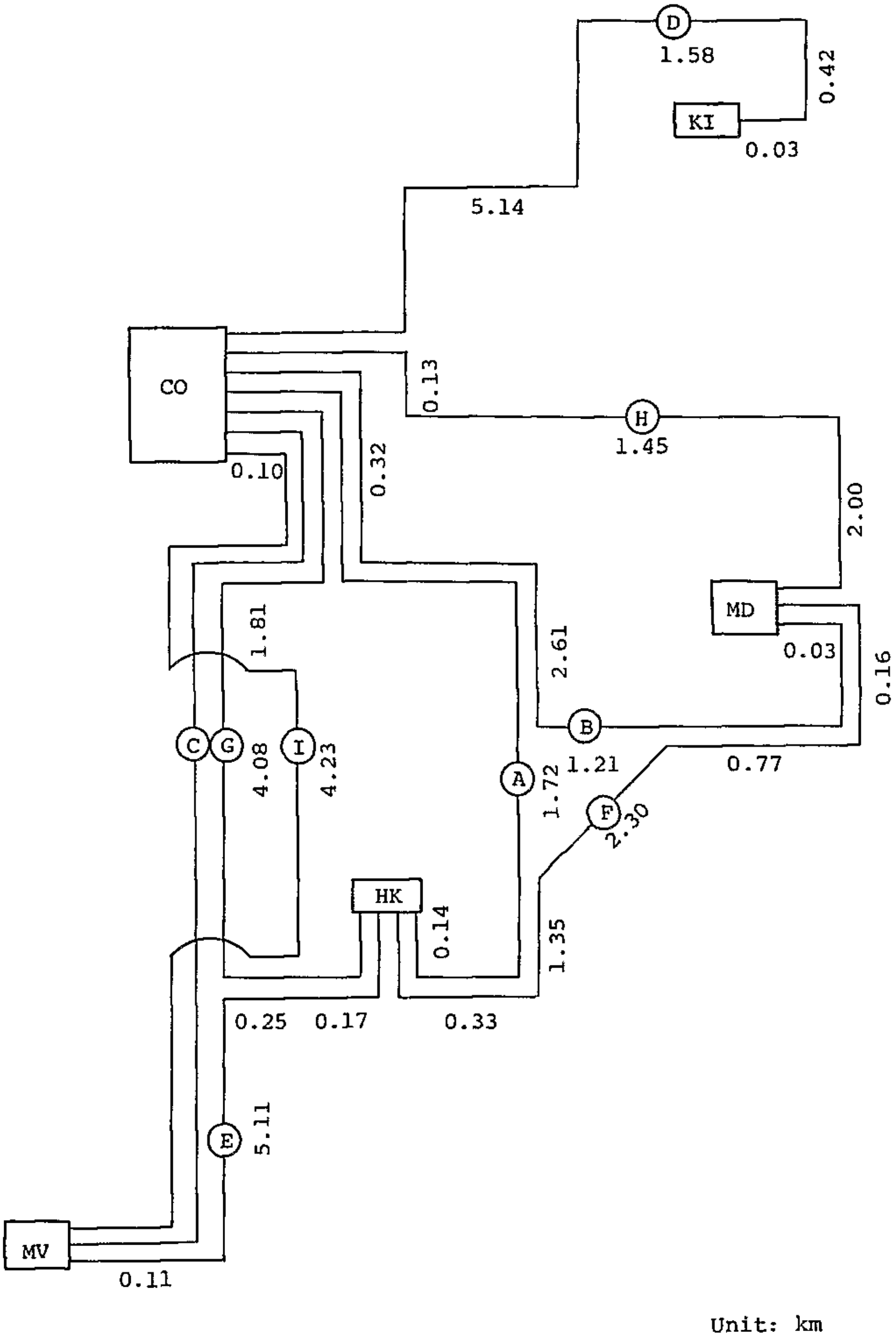



Figure 5-6     Diagram of Route Selection

5-5-3 Decision of Cable Pairs

(1) Cable pairs are so decided as to satisfy the circuit requirement 10 years ahead (i.e., as of 1997). This circuit requirement consists of the number of PCM systems plus the number of hot stand-by PCM systems plus the number of miscellaneous circuits.

(2) For the undermentioned sections, the existing cable pairs satisfy the circuit requirement 5 years ahead (i.e., as of 1992). Therefore, the additional cable pairs installation after those 5 years is economically advantageous. Such additional cable pairs installation is not included in the Project scope of work.

| | | |
|---|---|---|
| a) | WT Branch Point - JL Exchange | (10.62 km) |
| b) | KDW Branch Point - KDW Exchange | ( 8.52 km) |
| c) | WI Branch Point - KDL Exchange | (10.31 km) |
| d) | AN Branch Point - AN Exchange | ( 0.90 km) |
| e) | CO Exchange - KPT Exchange | ( 3.71 km) |
| f) | HC Branch Point - HC Exchange | ( 8.74 km) |
| g) | MHG Branch Point - HO Branch Point | ( 8.43 km) |
| h) | PYL Branch Point - PYL Exchange | ( 5.42 km) |
| | Total | 56.65 km |

5-5-4 Optical Fiber Cable System Design

(1) Between Colombo Central Exchange and Mt. Lavinia Exchange, the optical fiber cable transmission system is to be introduced. This transmission system is based on Digital 34 M system (wavelength: 1.3 μm; no inter-exchange repeating) shown in Table 5-10.

(2) The optical fiber cable transmission system is to have the built-in automatic changeover system to the stand-by system.

The existing PCM systems (10 systems) by PCQT cable in the Colombo Central Exchange - Mt. Lavinia Exchange section are to be maintained for the time being so that they can be used as alternative junction circuits for the optical fiber cable system whenever so required.

5-5-5 Underground Duct Design Principles

(1) In case the existing route leaves spare pipe(s) after new cable installation, additional pipe installation is not to be carried out.

(2) In case of additional pipe installation in the existing route, long span pipe that does not extend by way of the existing manhole is to be adopted in order to reduce the cable splicing points to the possible minimum.

(3) Pipe to be installed across the river and/or railway tracks and in the curved placed is to be of short span so as to ease cable installation in the pipe.

(4) For manhole locations, road intersections are to be avoided so that the maintenance and administration work will not impede surface traffic.

(5) Even if the existing route is the direct buried cable section, new duct is to be constructed wherein to install new cable by the Project.

(6) Calculation of Required Number of Pipes

1) Number of Cables

a) The number of cables is to be the number required 20 years ahead.

b) The number of cables required 20 years ahead is to be 1.3 times the number of cables to be installed by plan, i.e., 10 years ahead. (In this calculation, fractions are to be rounded up.)

2) Total Number of Cables 20 Years Ahead

a) In the case of a route where subscriber cables are to be accommodated in the junction route, the sum of junction cables plus subscriber cables is to be the number of cables 20 years ahead.

b) The number of cables 20 years ahead multiplied by the safety factor of 1.2 is to be the total number of cables 20 years ahead. (In this calculation, fractions are to be rounded up.)

3) Number of Pipes

The number of pipes is to be the sum of the total number of cables 20 years ahead plus the number of spare pipes.

(7) The identification numbers of manholes and the manhole dimensions appear in Table 6-1.

In the case of manhole where to install line repeater and loading coil, the cable rack is to be separated by not less than 100 cm from the basement.

### 5-5-5 PCM System Design

(1) PCM repeater spacing in the section where additional cable installation is scheduled is so determined as to harmonize with the existing repeater spacing. Refer to Table 5-11 and Figure 5-7.

(2) PCM hot stand-by system is established in each junction section. This is important from the viewpoint of securing junction network reliability.

The total number of PCM systems in each junction section as of 1992 and 1997 is given in Table 5-12.

(3) Figure 5-8 illustrates the relationship between the power supply distance to line repeaters and the number of repeaters. In HK Exchange - PK Exchange section, the distance exceeds the limit specified in the illustration so that the power supply from Maharagama Exchange is necessary.

## 5-6 Amount of Work

The amount of work required for junction network improvement and expansion in the Greater Colombo Telephone Network is shown in Table 5-13.

This work is to cover the section between terminal equipment of each transmission system of each exchanges.

Table 5-11 Line Repeater Spacing

| Conductor Diameter(mm) | d Max (km) | d End (km) |
|---|---|---|
| 0.65 | 2.31 | 1.15 |
| 0.9 | 3.16 | 1.58 |

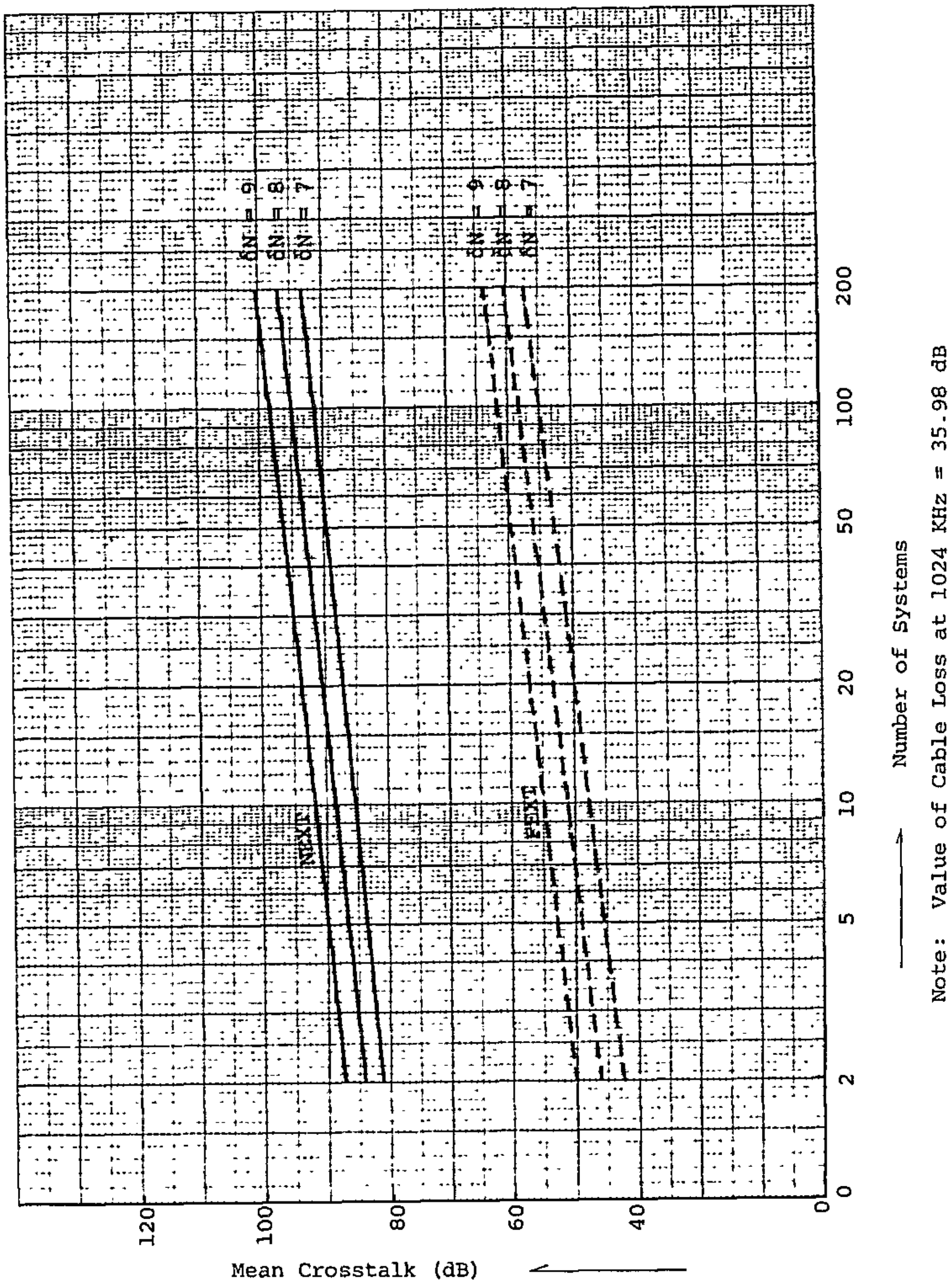



Figure 5-7 Mean Crosstalk vs Number of Systems

Table 5-12 Total Number of PCM Systems

| Section | | 1992 | 1997 |
|---|---|---|---|
| MSU — MSU | CO — HK | 75 + 7*2 | 123 + 1 |
| | CO — MD | 67 + 1 | 91 + 1 |
| | CO — MV | - 10*1 | - |
| | CO — KI | 59 + 1 | 79 + 1 |
| | HK — MV | 26 + 7*2 | 32 + 1 |
| | HK — MD | 32 + 1 | 42 + 1 |
| Total | | 259 + 15 | 367 + 5 |
| RSU — MSU | KI — WT | 14 + 1 | 19 + 1 |
| | KI — RG | 6 + 1 | 7 + 1 |
| | KI — JL | 14 + 1 | 22 + 1 |
| | KI — MAL | 10 + 1 | 18 + 1 |
| | KI — KDW | 10 + 1 | 18 + 1 |
| | Sub Total | 54 + 5 | 84 + 5 |
| | CO — MTK | 20 + 1 | 32 + 1 |
| | CO — KPT | 24 + 1 | 36 + 1 |
| | Sub Total | 44 + 2 | 68 + 2 |
| | HK — ND | 35 + 1 | 52 + 1 |
| | HK — MHG | 15 + 1 | 22 + 1 |
| | HK — HO | 7 + 1 | 11 + 1 |
| | HK — PK | 6 + 1 | 6 + 1 |
| | Sub Total | 63 + 4 | 91 + 4 |
| | MD — WI | 10 + 1 | 18 + 1 |
| | MD — AN | 7 + 1 | 14 + 1 |
| | MD — KDL | 6 + 1 | 7 + 1 |
| | MD — KX | 27 + 1 | 43 + 1 |
| | MD — HC | 3 + 1 | 6 + 1 |
| | Sub Total | 53 + 5 | 88 + 5 |
| | MV — MF | 22 + 1 | 34 + 1 |
| | MV — PYL | 6 + 1 | 6 + 1 |
| | MV — BS | 6 + 1 | 6 + 1 |
| | Sub Total | 34 + 3 | 46 + 3 |
| Total | | 248 + 19 | 377 + 19 |

Note:
*1: Alternative systems for Optical Fiber Transmission Systems.

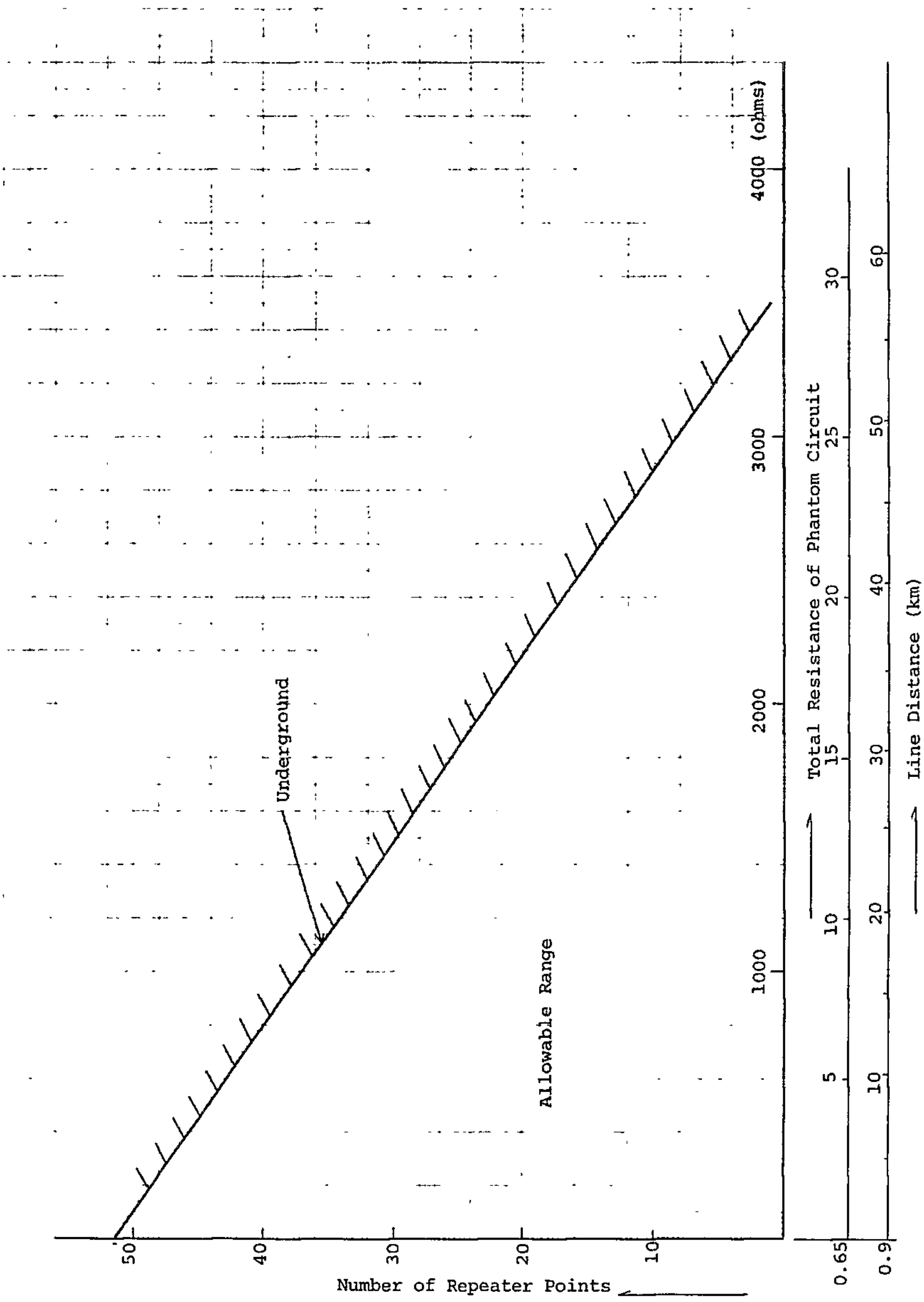



Figure 5-8 Maximum Power Feeding Distance

Table 5-13 Amount of Main Work

| Group | Section \ Main Work | Duct-in Cable (km) | Manhole (ea) | Ducts (km) | Termination: Pairs | Termination: Cables | Line Repeater (ea): Repeater | Line Repeater (ea): Housing | Terminal Equipment (Sys) |
|---|---|---|---|---|---|---|---|---|---|
| MSU — MSU | CO — HK | 6.7 | 2 | 4.7 | 800 | 2 | 114 | 3 | 124 |
| | CO — MD | 3.5 | | | 800 | 2 | 62 | 2 | 40 |
| | CO — MV | *1 11.7 | 19 | 4.0 | 12 *1 | 2 | | | *2 120 |
| | CO — KI | 7.3 | 16 | 2.8 | 600 | 2 | 147 | 4 | 60 |
| | HK — MV | | | | | | 78 | 3 | 36 |
| | HK — MD | | | | | | 75 | 3 | |
| | Sub Total | 29.2 | 37 | 11.5 | 2200 *1 12 | 8 | 476 | 15 | 380 |
| MSU — RSU | KI — WT | 2.0 | 25 | 4.2 | 200 | 1 | 74 | 2 | 71 |
| | KI — RG | 7.0 | 17 | 2.8 | 30 | 1 | 82 | 2 | 7 |
| | KI — JL | | | | | | 36 | | 11 |
| | KI — MAL | 15.8 | 93 | 15.7 | 144 | 2 | 72 | 8 | 11 |
| | KI — KDW | 0.5 | | | 72 | 1 | 43 | 1 | 11 |
| | Sub Total | 25.3 | 135 | 22.7 | 446 | 5 | 307 | 13 | 111 |
| | CO — MTK | 3.7 | | | 300 | 2 | 42 | 2 | 38 |
| | CO — KPT | | | | | | 26 | | 14 |
| | Sub Total | 3.7 | | | 300 | 2 | 68 | 2 | 52 |
| | HK — ND | 4.3 | 7 | 1.1 | 200 | 2 | 34 | 2 | 68 |
| | HK — MHG | 9.4 | 22 | 3.6 | 250 | 2 | 131 | 5 | 12 |
| | HK — HO | | | | | | 45 | | 8 |
| | HK — PK | 12.3 | 72 | 12.3 | 28 | 2 | 30 | | 7 |
| | Sub Total | 26.0 | 101 | 17.0 | 478 | 6 | 240 | 7 | 95 |
| | MD — WI | 4.2 | 14 | 2.2 | 300 | 2 | 52 | 2 | 47 |
| | MD — AN | 0.8 | | | 100 | 1 | 37 | 1 | 8 |
| | MD — KDL | | | | | | 15 | | 7 |
| | MD — KX | 5.8 | 19 | 2.9 | 350 | 2 | 81 | 3 | 16 |
| | MD — HC | | | | | | 10 | | 4 |
| | Sub Total | 10.8 | 33 | 5.1 | 750 | 5 | 195 | 6 | 82 |
| | MV — MF | 8.2 | 21 | 3.4 | 300 | 2 | 92 | 4 | 47 |
| | MV — PYL | | | | | | 12 | | 7 |
| | MV — BS | 5.9 | | | 60 | 2 | 21 | 3 | 7 |
| | Sub Total | 14.1 | 21 | 3.4 | 360 | 4 | 125 | 7 | 61 |
| Grand Total | | 109.1 | 327 | 59.7 | *1 12 4534 | 30 | 1411 | 50 | 781 |

Note
*1 : Optical Fiber Cable
*2 : In 30 Channels

# CHAPTER 6

# SUBSCRIBER CABLE NETWORK PLAN

# CHAPTER 6 SUBSCRIBER CABLE NETWORK PLAN

This chapter presents the basic principles for execution of subscriber cable network imporvement and expansion plan covering seven exchanges in the Greater Columbo Area. Basic design drawings are in accordance with those basic principle. The seven exchanges are:

1) Colombo Central
2) Mattakkuliya
3) Maradana
4) Havelock Town
5) Nugegoda
6) Mt. Lavinia
7) Boralesgamuwa

## 6-1 Subscriber Cable Design Standards

### 6-1-1 Provisioning Period

(1) Underground duct system

20 years ahead (to meet demand as of 2007)

(2) Primary cable

5 years ahead (to meet demand as of 1992)

(3) Secondary cable

15 years ahead (to meet demand as of 2002)

### 6-1-2 Distribution of Subscriber Cable Network

Various distribution systems of subscriber cable network, which has its own merits and demerits, are to be considered. The distribution system to be adopted is determined in consideration of procurability of necessary materials, adaptability to natural environment, ease of maintenance, and so forth.

(1) Present Distribution System

The systems adopted in Sri Lanka at present are these two:

1) Direct distribution system

This system is used for primary cable installation directly from MDF to the cable distribution point.

2) Cabinet system

The cabinet system uses the cross-connecting cabinet on the cable line and makes jumper connection of primary and secondary cables in the cabinet.

(2) Distribution System in the Project

In the Project, the above two systems of subscriber cable network are used in the following ways:

1) Direct distribution system

In the nearby area of each exchange.

2) Cabinet system

In other area than 1) above.

## 6-1-3 Determination Cabinet Area

The cabinet area remains fixed for a long period. It serves as the demand and facilities management unit to promote the effective use of facilities and their most appropriate expansion. Therefore, it must be so determined that the cable installation design, execution and maintenance work can be carried out without hitches and at top efficiency.

### (1) Method of Area Determination

The cabinet area is determined, using the river, railway, highway and/or administrative block, plus local features, as a boundary. The existing facilities configuration must also be taken into consideration. The demand size within one cabnet area 15 years after (i.e., in the 2002) estimated at 800 or 400 is another guideline.

### (2) Cross-Connecting Cabinet Establishment

One cross-connecting cabinet is used in one cabinet area. The location where to establish the cabinet is at the nearer side to the exchange. It must be the location that allows the primary and secondary cable installation at top efficiency and at reasonable cost, does not impede pedestrian and vehicular traffic, and facilitates the maintenance work and related management.

## 6-1-4 Cable Line Formation

Subscriber cable comprises primary cable and secondary cable. For cable laying the methods available are fourfold. They are duct-in cable method, direct buried cable method, aerial cable method and in-door cable method.

(1) Primary cable means all subscriber cables between MDF and cross-connecting cabinet and, in the area where the direct distribution system is used, between MDF and the first cable distribution point. In principle, primary cable is installed as duct-in cable.

(2) Scondary cable means all subscriber cables between the cross-connecting cabinet and each cable distribution point and, in the area where the direct distribution system is used, between the first cable distribution point on the exchange side and each other cable distribution point. In principle, secondary cable is installed as duct-in cable, aerial cable or in-door cable.

Duct-in cable is used in the areas where the use of aerial cable is not appropriate as in the densely housed residential areas along the highway, and also, in the areas where aerial cable installation is not appropriate, from the viewpoint of urbanization and for other reasons.

6-1-5 Underground Duct System

Underground duct must be so designed that the construction cost is reasonable. Also to be cosidered in the underground duct design are safety, maintainability and ease of work.

(1) Route Selection

Route selection for underground duct is to be made, based on field survey findings, as well as city planning and associated data. Also to be considered are technical difficulties that can be foreseen from the viewpoints of construction and maintenance. Guidelines are:

1) Utilization of Existing Underground Facilities

For the pourpose of effective use of existing underground facilities, the design is to be made as under:

a) In case where an idle pipe exists besides the spare duct, new cable is to be installed in the idel pipe.

b) In case where no idle pipe exists, small pair cable is to be re-located so as to produce the pipe for new cable, provided that the cost and work conditions permit such re-location. Otherwise, decision is made for constructing new pipe.

2) Construction of New Duct

When constructing a new Duct route, the following are prerequisite:

a) To choose the road where the duct route can be shortest.

b) To choose the road fit for establishing the corss-connecting cabient.

c) To choose the road not to be reduilt or disused by the city planning.

d) To choose the road whose crossings of rivers, bridges and railways are the minimum.

e) To choose the road where underground facilities are few so that the underground duct construction is easy.

f) To choose the road wide enough to least disturb surface traffic during the duct construction work.

g) To choose the road that is not paved yet.

(2) Calculation of Required Number of Pipes

1) Number of Pipes

The number of pipes is to be the number of cables, multiplied by the safety factor, plus the number of spare pipe(s).

2) Number of Spare Pipe(s)

The number of spare pipe(s) is to be determined according to the number of cables to be accommodated. The standard number of spare pipe(s) is as under:

| Number of Cables to be Accommodated | Number of Spare Pipe(s) |
|---|---|
| 1 - 15 | 1 |
| 16 - 30 | 2 |
| 31 and over | 3 |

3) Safety Factor

The safety factor is determined as 1.2. This safety factor determination is in consideration of demand size variation 20 years after, as well as the road network configuration, road planning and road traffic condition plus underground facilities foreseeable as of that future.

4) Number of Lead-in Pipes

Lead-in pipes constitute part of exchange building. They must be established in a sufficient number not to necessitate additional installation in the future.

(3) Pipe

1) Type of Pipe

The pipe is to be the PVC pipe or steel pipe.

2) Diameter of Pipe

The diameter of pipe is to be 100 mm in inner dismeter.

(4) Span between Manholes

The span between manholes is determined in consideration of cable branching, cross-connecting cabinet location, and road situation. In no case should the span be longer than the maximum limits shown below.

Straight section: 200 m

Curved section : 100 m

(5) Duct Location

In case where the carriageway and sidewalk are distinctly separated, the sidewalk is the priority choice for duct construction. Where there is no distinction between carriageway and sidewalk, the road shoulder is used for duct construction.

(6) Manhole and Joint Box

The manhole is established at each cable connecting/ branching point, PCM repeater and loading coil locations, and other key place for maintenance.

1) The size of manhole is determined in consideration of the undermentioned items.

   a) The number of pipes required.

   b) Available space for work.

   c) Enclosure for cable splicing

   d) Loading coil

   e) PCM repeater

   When determining the type of manhole to accommodate junction and trunk cables, consideration must be made about the junction cable expansion plan.

2) The joint box is established between the manhole and cross-connecting cabinet. For the purpose of convenience for maintenance and related management, the joint box is to be established on the sidewalk. Where no sidewalk exists, the road shoulder is used for joint box establishment.

### 6-1-6 Subscriber Cable Standars

In consideration of the future maintenance system and the possible provision of new telephone services, the subscriber cable is to be used according to the undermentioned standards.

(1) Primary Cable

Cable to be used for primary cable is to be PE insulated, PE sheathed, jelly filled cable. This cable is to be used in the underground duct section.

(2) Secondary Cable

Cable to be used for secondary cable is to be PE insulated, PE sheathed, jelly filled cable. This cable is to be used in the underground duct section.

When adopting the direct buried system, the cable is to be armored cable.

For the area where the aerial system is applied, the cable should be the PE insulated, PE sheathed, self-supporting type.

Cable to be used for the in-door cable system should be the PE insulated, PE sheathed plain type.

### 6-1-7 Subscriber Line Loss and D.C. Resistance Limit Value

The subscriber line loss value is determined as part of the transmission loss distribution value on the subscriber to subscriber speech system. (Refer to Chapter III.) In the Project, the loss value is set at 8 dB (at 1,500 Hz).